BC
108
.E5
1865a

LIBRARY OF CONGRESS
1800

o5a

VOL. 150. PRICE 1s. 6d.

A

TREATISE ON LOGIC,

PURE AND APPLIED.

BY S. H. EMMENS, ESQ.

VIRTUE BROTHERS & CO., 1, AMEN CORNER, PATERNOSTER ROW.

PRIZE MEDAL, INTERNATIONAL EXHIBITION, 1862,
was awarded to
MESSRS. VIRTUE,
for
the "publication of
WEALE'S SERIES."
See JURORS' REPORTS,
CLASS XXIX.

RUDIMENTARY, SCIENTIFIC, EDUCATIONAL, AND CLASSICAL WORKS.

FOR C ...HOOLS,

MECH... ..., &c. &c.,

VIRT... ...RNER,

*** THE... ...ON WOOD

Th... ...hole of the late MR... ...ving Cata-logue, h... ... Co., *and that all* ... 1, AMEN CORNE...

*** Ad... ...reparation.

Natura... ...f, for the use o... ...of Natural Scien... ..., 1s.

Pneumatics; for the use of Beginners. By CHARLES TOMLINSON. Illustrated, 1s.

Perspective for Beginners; simplified for the use of Juvenile Students and Amateurs in Architecture, Painting, &c. By GEORGE PYNE. Illustrated, 2s.

LIBRARY OF CONGRESS 1800
Class BC 108
Book .E5
1865a

The Mollusca, a Manual of; or, a Rudimentary Treatise of Recent and Fossil Shells. By S. P. WOODWARD, Associate of the Linnean Society, Assistant in the Department of Mineralogy and Geology in the British Museum. Illustrated, 5s. 6d.

The Painter's Art, Rudiments of; or, a Grammar of Colouring applicable to Operative Painting, Decorative Architecture, and the Arts. By GEORGE FIELD. Illustrated, 2s.

Painting on Glass, or Glass Staining, the Art of; comprising Directions for preparing the Pigments and Fluxes, for laying them upon the Glass, and for Firing or Burning in the Colours. From the German of Dr. GESSERT. To which is added an Appendix on the ART of ENAMELLING, &c. 1s.

Painting on Glass, the Art of. From the German of FROMBERG. 1s.

The Law of Contracts for Works and Services. By DAVID GIBBONS. 1s.

Clay Lands and Loamy Soils; comprising the Origin and Chemical qualities of each variety of Land—Natural Properties of the Soils and Mode of Cultivation—Cropping and Value of the Lands, and changes effected by mixing with Hot Lime. By Professor DONALDSON. 1s.

Music, a Rudimentary and Practical Treatise on. By CHARLES CHILD SPENCER. 2s.

The Pianoforte, the Art of Playing, with numerous Exercises and Lessons, written and selected from the best masters. By CHARLES CHILD SPENCER. 1s.

J. Davis Barnett.
1916.
* 39382

A

TREATISE ON LOGIC,

Pure and Applied.

BY

S. H. EMMENS, ESQ.

LONDON:
VIRTUE BROTHERS & CO., 1, AMEN CORNER,
PATERNOSTER ROW.
1865.

BC 108
.E5
1865a

Exchange
Western Ont. Univ. Library

JUL 10 1940

4750
6451
RS 19 Jy 40

PREFACE.

68

Little more will be expected from a work of the following description, than that it should contain an intelligible and concise exposition of those facts and principles which form, as it were, the groundwork of logical science. Necessarily, therefore, it must be, for the most part, a compilation of such views as have obtained general acceptance, and can lay but little claim to any high degree of originality.

At the same time, I may be permitted to state that some features exist which serve to distinguish this Treatise from its numerous predecessors, and which will, I hope, prove of service to the student by inciting him to examine for himself such theories and principles as come under his notice. Those features to which I more particularly allude, are the reference of all so-called "Immediate Inferences" to the class of syllogisms; the grounds for an extended adoption of Aristotle's *Dictum;* the refutation of the charge that every syllogism involves a *petitio principii;* the explication of the inductive theory in Applied Logic; and, finally,

the doctrine of classification, by which every detail and branch of Logic is shown to exist in harmonious unison. And as these views are, in a measure, opposed to those contained in works of great repute, I have appended to the body of this Treatise four Articles, wherein are set forth such arguments as I think sufficient to justify me in advancing the above-mentioned doctrines.

I also deem it advisable to state that it has been my endeavour to give this work as *suggestive* a character as possible; and, therefore, although it belongs to a rudimentary series, professing to treat only upon the first elements of Logic, I am yet not without hope that it will be found a sufficient introduction to such comprehensive and elaborate treatises as those of Mr. Mill, Professor De Morgan, and others. But while I have thus been compelled to satisfy myself in many cases with an enunciation rather than with a full investigation of certain doctrines, I still trust that, in the following pages, the student will find all that is really requisite to give him a fair, practical knowledge of Logic.

The chapter on Applied Logic is, I am sensible, but a mere sketch. As, however, to do justice to so vast a subject would require a great extension of the present limits, and would thus curtail the utility of this Treatise by enhancing its price, I have contented myself with directing the student's attention to such points as are most important, both in theory and practice. For the same reason, nothing beyond the bare outlines is given of such new doctrines as I have here

adopted; all further development of them being deferred to a future occasion.

I take this opportunity of acknowledging my many and great obligations to those writers upon Logic whose works I have consulted; and although it may seem invidious to particularise, yet as, for reasons which will be found specified in their proper place, I have expressly referred to Mr. John Stuart Mill, as being the advocate of certain opinions which are combated in the following pages, I think it only just that I should here record my admiration for the profound philosophy and great attainments which are so apparent in the writings of that gentleman.

S. H. E.

London, January, 1865.

CONTENTS.

Page

INTRODUCTION 1

CHAPTER I.

AN INQUIRY INTO THE VARIOUS MEMBERS OF AN ARGUMENT . . 7

CHAPTER II.

OF NOTIONS OR TERMS:—

§ 1. Simple-apprehension 14
2. Abstraction of Common-notions 16
3. Predicables, Extension, and Intension 18
4. Division of Common-notions 18
5. Positive, Negative, and Privative Terms 20
6. Definition 21
7. Names and their Divisions 22
8. Opposition of Terms 23
9. Structure of Terms 24
10. Conclusion and Recapitulation 24

CHAPTER III.

OF JUDGMENTS OR PROPOSITIONS:—

§ 1. Formation of Judgments 27
2. Categorical Propositions 28
3. Hypothetical or Conditional Propositions 29
4. Disjunctive or Alternative Propositions 29
5. Quantity of Propositions 30
6. Quality of Propositions 30
7. Distribution of Terms 31
8. Relation of Terms 32

Page
9. Systematic Classification of Propositions 33
10. Table of Possible Propositions 33
11. Interpretation of the Copula 34
12. On some other Properties of Judgments 35
13. Concluding Remarks 35

CHAPTER IV.

Of Reasoning or Argument—Syllogisms:—
§ 1. Reasoning in General 38
2. Syllogisms—Inference 39
3. Opposition 41
4. Conversion 44
5. Coincident Junction 47
6. Mediate Inference formally expressed as such—its Divisions 48
7. The Fundamental Law of Mediate Inference 49
8. Of Figure 54
9. Remarks upon the Four Figures 54
10. Of Mood or Mode 57
11. Table of Valid Syllogisms 58
12. Induction and Deduction 61
13. Extension and Intension 64
14. Denomination 66
15. Syllogistic arrangement of Propositions 66
16. Conditional Syllogisms 67
17. Disjunctive Syllogisms 72
18. The Dilemma 73
19. Incomplete Syllogisms 75
20. Complex Arguments, or Chains of Reasoning 76
21. Recapitulation 80
22. Conclusion 82

CHAPTER V.

Of Fallacies:—
§ 1. Applied Logic in genera. 84
2. Classification of Fallacies 85
3. Formal Fallacies 88
4. Material Fallacies—Quarternio Terminorum 90
5. Material Fallacies—Premiss unduly assumed 95
6. Material Fallacies—Ignoratio Elenchi 111
7. Conclusion 115

CHAPTER VI.

Page

Of Logic as Practically Applied:—

§ 1. Introductory Remarks 117

2. Observation 119

3. Reflection—

1°. Of Laws and Causes 126

2°. Of Induction 131

3°. Of Deduction, Hypothesis, and Verification . . . 140

4°. Of Analogy 143

5°. Of Chance and Probability 145

6°. Examples of Reflection—

a. The Discovery of Neptune 148

b. Kirchhoff's Researches on the Solar Spectrum . 150

4. Conclusion 152

APPENDIX.

A On Judgments 155

B. On the so-called Immediate Inferences 159

C. On the Dictum de Omni et Nullo 163

D. On the Syllogism considered as a *Petitio Principii* . . . 166

LOGIC.

INTRODUCTION.

Logic may be not inaptly described as the grammar of thought; that is to say, it reveals and explains the principles according to which our judgments are formed, in much the same manner as grammar analyses the laws which regulate the expression of our thoughts by means of speech. It will, therefore, be seen that Logic is a science of universal extent, inasmuch as wherever any process of reasoning is carried on, there will be found, in full operation, those mental laws which it is the office of Logic to examine and systematise. It does not, however, follow that every person who reasons is a logician, for it is only when a process of judgment is carried on in regular order, and according to the rules derived from a study of the science, that such an appellation could be justly bestowed. And, in like manner, it would be absurd to suppose that there can be no correct reasoning without a good knowledge of Logic; for, in order to perceive the error of such a view, we have only to consider for a moment the mode in which every science is formed. Take, for example, the science of astronomy: the heavenly bodies had been urged through space, by the operation of definite cosmical laws, for ages previous to the discovery of those laws by human philosophers, and it was the very fact of such motions being in progress, which led to the investigation of the principles concerned.

Thus, too, with regard to Logic: men had thought and reasoned according to certain laws, long before Aristotle, by observing and reflecting upon the various judgments which came under his notice, was able to enunciate the great fundamental truth upon which they were based. It is from considerations such as these that we speak of scientific *discoveries*, and not of scientific *inventions;* for the latter term can only be applied to some *new method of accomplishing* a specific object, while the former is always used when we speak of any fresh *law or principle*, which, previously existing, has been brought to light by the exertions of the philosopher. Like, then, as Newton discovered gravitation, so did Aristotle discover the syllogism; and, therefore, the notion that the use of the syllogism is merely *one method* of reasoning, is at once shown to be altogether erroneous. The truth is, that there can be *no other* process of forming a judgment, since every conceivable example of reasoning may, by the application of certain rules, be reduced to the syllogistic form.

From what has now been said, the true value of Logic will be easily discerned, and as its subject is one which lies at the root of all other sciences, its importance can hardly be overestimated. Its principal use is that it enables us to reason correctly, by furnishing us with various rules and standards wherewith to test the validity of any argument that may be brought before us. And here it is requisite to guard against a very prevalent misconception; I allude to the idea, that, by means of Logic, one may ascertain the *truth or falsehood* of any statement. The source of this error is to be found in the supposition that Logic is concerned with the *subject* of the various statements (technically, propositions) whose relations to each other it investigates; whereas, in reality, it merely considers their *form*. Thus, the two propositions, "Water is a fluid," and, "Evil is good," would by a logician be considered as precisely similar, although one of them is false,

and the other true. Again, the following argument or syllogism—

All fluids are poisonous,
Water is a fluid;
Therefore Water is poisonous,

is perfectly valid and correct, although the conclusion arrived at is false. To render this point quite plain and intelligible, let us adopt the following course: it was above stated that Logic merely considers the *form* and not the *subject* (or *matter*) of propositions; accordingly, for all logical purposes, we shall not alter the nature of the propositions employed, if we substitute letters for the words we used to express the substances or notions of which we spoke. Thus, instead of "water is a fluid," let us say "A is B," and for "evil is good," let us put "C is D:" we then see at once, that in both instances we use exactly the same kind of proposition. Again, let us similarly convert the syllogism: we have—

All A's are B,
C is an A;
Therefore C is B;

an argument which remains unalterable in *form*, no matter what ideas are expressed by the letters.*

This it is which confers such rigorous accuracy upon all the results and developments of Logic. Indeed, as Professor De Morgan has said, Mathematics and Logic are the two *exact* sciences. The primary doctrines of chemistry may require alteration as new combinations of the elements are brought to light; the progressive theories of physiology are modified with every advance of microscopical investigation; the glorious revelations of astronomy present an ever-changing aspect; but Logic, like Mathematics, abides, eternal and immutable.

The preceding remarks will probably have pointed out to the reader that Logic is concerned with language as distin-

* For further information as to form and matter see page 39 *et seq.*

guished from the ideas conveyed by the use of words; but in order that the student may be well grounded in the fundamental truths of the science before he proceeds to study its details, I shall add some further observations upon this point.

Language in its ordinary sense, that is, speech, is useful as a means of communication in two ways: it enables us to minutely describe, or, in other words, to analyse, our various ideas, and it also enables us to convey, by a single sound or sign, the combined impression of many particulars. Take, for example, this description:

> "I gazed upon her form
> Transcendent, and upon her face which gleamed
> Pale through her tears, like some fair statue bathed
> In the cold moonlight; and I marked the mute,
> Sad eloquence of that love-charged heart
> Which quickly heaved its alabaster veil
> In trembling fear."

Here gradually dawn upon us the many subjects of attention which exist in a single object, and it is only by means of a protracted analysis such as the above, that we are able to convey a complete idea of it. But then, again, we sometimes wish to express the notion of a numerous class of objects, in such a manner that the impression produced may serve for any one of them. Thus, suppose the objects were men, horses, cows, sheep, lions, &c.: we should merely confine our attention to those points in which they resembled each other, and should bestow a name upon this group of qualities, such as "animal," by the use of which we might attain the desired end. This process is the reverse of the first, but at the same time is in a measure dependent upon it, for in order to ascertain the points of resemblance between various objects, a partial analysis is at all events necessary. Accordingly, Logic takes cognizance of both operations, and investigates the relations which subsist between them and the act of reasoning itself.

It has been said above that language enables us to convey, by a single sound or sign, the combined impression of many particulars. Now it is our ability to do this, which alone enables us to conduct a process of reasoning ; or otherwise we should find it impossible to judge of the relations between two ideas or objects—a condition which is evidently essential to an argument. One of the most curious proofs of this is afforded by deaf-and-dumb persons, who, when they have once been taught to speak by means of their fingers, are observed to use this means of recording their impressions, even when thinking alone. And it has been asserted, that "it will be found by any one who will question a deaf-mute who has been taught language after having grown up, that no such thing as a train of reasoning had ever passed through his mind before he was taught."*

We have hitherto considered Logic purely as a Science, but it is very frequently regarded as an Art, and perhaps it is this mode of viewing it which holds out the strongest incentive to the student. For it can only be the few who will voluntarily engage in the study of principles which, complete in themselves, give promise of no result beyond that delight which naturally arises from the consideration of organic symmetry and perfection ; the great majority being altogether occupied with the hope of turning their knowledge to some useful purpose. Therefore, in the following pages I shall endeavour to give as practical an effect as possible to the various laws of thought which we shall investigate ; and the student will thus find that Logic, instead of being merely an "ingenious recreation," is in reality a powerful aid to the prosecution of all other studies. Not that reasoning alone will suffice for the *discovery* of truth, as to do this an extended *observation of facts* is indispensable ; but when we have collected a sufficient quantity of facts, we shall find that an

* Whately's "Logic," p. 13.

acquaintance with Logic will greatly assist us in deducing a correct inference.

I now trust that a tolerably clear notion has been gained of the nature and extent of Logic; and in the next place I shall briefly describe the method of proceeding which I intend to adopt in my explanation of the science. First, then, it will be advisable to select some example of pure reasoning, and, having dissected it, to point out the various members of which it is composed, together with the principles which form, as it were, the framework of the structure. We shall thus obtain a bird's-eye view of the country before us, and we shall be able to advance without doubt or hesitation to the end of our journey. Accordingly, it will next become our duty to examine each branch separately and in detail, which being done, we shall proceed to the consideration of the various combinations formed by these branches, and so at length we shall be enabled to construct, or to analyse at pleasure, any train of argument, however extensive it may be. Here, strictly speaking, the study of Logic as such should terminate; but in order that the utility of this treatise may be increased, I shall devote a chapter to the discussion of the several fallacies which are of most frequent occurrence, giving such rules for their treatment as have been found most effectual. The concluding portion of the work will consist of some remarks upon the proper application of Logic, with various illustrative examples.

Such is the course which I propose to take, and if the student be not dismayed by the shadowy anticipation of technical difficulties which have no real existence, he will find an ample reward for all his labours. A systematic regulation of his intellect; a probe wherewith to examine the most mysterious doctrines of philosophy; a wand before whose potent touch the stately fabric of deceit and fraud will disappear;—these are but a few of the benefits to be obtained by a study of Logical science.

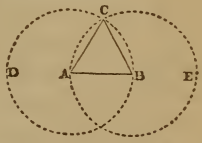
A TREATISE ON LOGIC.

CHAPTER I.

AN INQUIRY INTO THE VARIOUS MEMBERS OF AN ARGUMENT.

It has already been stated that our first step towards a right understanding of Logic must be a strict examination of some definite argument. Now, as we are not all concerned with the *subject* of the reasoning, it will be the best plan for us to choose some example which shall present us with the fewest and most simple ideas, so that we may devote our whole attention to the reasoning *process*, and not be led aside by any extraneous matters. Accordingly, let us take for the subject of our investigation, the proof of Euclid's first proposition, which may be thus stated in arguments or syllogisms.

1. The radii of the same circle are equal to one another,
   A C and A B are radii of the same circle B C D;
   ∴ A C is equal to A B.



2. The radii of the same circle are equal to one another,
   B C and A B are radii of the same circle A C E;
   ∴ B C is equal to A B.
3. Things which are equal to the same thing are equal to one another,
   A C and B C are equal to the same thing (viz. A B);
   ∴ A C is equal to B C.

Taking any one of the above syllogisms, we see that it is composed of three statements, among which this relation subsists; that if we admit the truth of the first two, we cannot

avoid admitting the truth of the last. This last statement is termed the *conclusion*; the other two being called the *premises*. And here the question comes—why is it, that, having admitted the premises, we are compelled to admit the conclusion? To answer this we must examine the constitution of each premiss, and ascertain whatever is implied thereby. Thus, in the first of the syllogisms given above, we find as a commencement, the following assertion or proposition:—"radii of the same circle are equal to one another:" where a certain property, viz., "equality," is asserted, or, in logical language, *predicated*, of a group or class of objects, viz., "radii of the same circle." That is to say, "equality" is a property common to every individual comprehended in the class. The second proposition is to this effect:—"A C and A B are radii of the same circle;" that is, we assert A C and A B to be individuals of that very class, concerning which we admitted that "equality" was common to every one of its members. Consequently we are compelled to admit that A C and A B possess the property of "equality," and this admission forms the conclusion.

Our mode of procedure has therefore been as follows: we first predicate something of a certain class of objects; we then assert that certain individuals belong to that class; and lastly, we predicate the same thing of the individuals which we had predicated of the class.

Now suppose the syllogism had stood thus: "Radii of the same circle are *not* equal to one another; A C and A B are radii of the same circle; therefore A C is not equal to A B:" it would still be perfectly valid, for, having denied that a certain property is enjoyed by a class of objects among which we admit certain individuals to be, we must necessarily deny that those individuals possess the property in question.

We thus arrive at this axiom or law: "Whatever is affirmed or denied altogether of any whole, may in like manner be affirmed or denied of any individual part belonging to, or comprehended in, that whole." Aristotle was the first who distinctly enunciated this great truth, and it is commonly known as "Aristotle's Dictum," or the "*dictum de omni et nullo*."

It may at first seem strange that a statement so simple and obvious should be characterised as a great truth ; but a very little reflection will soon convince us that any law which is of universal extent and application, must be the more valuable according as it is the more simple ; and therefore it is with justice that Aristotle is honoured for having enabled us to explain the formation and examine the validity of any argument whatever, in so plain and satisfactory a manner. Another fact also which will appear improbable, is that the dictum may be universally applied ; that is to say, no syllogism can be valid or admissible unless it strictly complies with the requirements of the dictum, and in a later portion of this work rules will be found by means of which it is possible to bring every specimen of reasoning to this test. Indeed, if we would become thoroughly acquainted with the principles of logical science, we must invariably bear in mind the dependence of every train of thought upon the dictum of Aristotle.

But it is now time that we should revert again to our example of reasoning, and continue the division of each syllogism into its component parts. We have already seen that a syllogism consists of three propositions divided into the two premises and the conclusion ; we will now examine the propositions themselves more closely. In the statement "radii of the same circle are equal to one another," we see three distinct portions : first, the subject of which we are speaking, and of which something is predicated (that is, asserted or denied) ; secondly, the attribute or condition which is predicated of the subject ; and thirdly, the sign of affirmation or negation. The technical names for these are, the *subject*, the *predicate*, and the *copula*.

In the proposition above quoted it will be observed that the *whole* of the subject is spoken of ; for when we say "radii of the same circle," we evidently mean every radius that could possibly be drawn. Accordingly, such a proposition is termed *universal*, as the predicate is universally applied to every part of the subject. But if we had spoken of a portion only of the subject, and had said "*some* of the radii of the same circle are equal to one another," we should have what is called a *particular* proposition, inasmuch as the predicate

is affirmed of some particular *part* of the subject, and not of the *whole*. Thus we see that propositions may be always divided into universal and particular, and this distribution is said to be made according to quantity.

Again, "equality" is predicated affirmatively of "radii of the same circle;" the sentence is therefore termed an *affirmative* proposition: while if the predicate had been denied of the subject, thus, "radii of the same circle are *not* equal to one another," it would have been a *negative* proposition. We have, therefore, another system, by means of which to classify every possible proposition, and this distribution is called a division according to *quality*.

And here we have introduced to our notice a very important branch of Logic, namely, division; by means of which mental process we may at all times obtain a distinct grasp of any subject which occupies our attention. Indeed, this faculty would seem to be an inherent principle of our nature, for whatever may be the science, an attempt has always been made from the commencement, to properly classify and arrange its various subdivisions; the best examples of such a course being found in such studies as Natural History, Comparative Anatomy, &c. Accordingly, as Logic instructs us concerning the principles upon which alone a perfect division can be performed, it is an additional proof of the necessity which exists for an intimate acquaintance with that science.

We have now glanced quickly, but I trust intelligibly, at the structure of a syllogism and its component propositions. It remains that we should consider the nature of the *materials* of which the propositions are formed, having already discussed the mode of framing them together. The subject of the first proposition is, "radii of the same circle;" and in saying this we speak of a class, the individuals of which, though they may differ among themselves in many respects, yet have some features common to all. Thus, one radius of a circle will be unlike its fellows as regards position, but it will be exactly similar with respect to magnitude. So, when speaking of a given circle we mention its "radius," we employ a name that may be applied to any straight line whatever that is

drawn from the centre to the circumference. Such a word is called by logicians, a *common-name* or *common-term*, because, as just stated, it is enjoyed in common by a multitude of objects. But if we proceed to the subject of the second proposition, we are met by terms which differ entirely from the preceding, viz., "A C and A B," the names given to individual radii. These of course can only be applied to a single object, and are consequently known as *singular-terms*, thus serving to distinguish the various members of a common-term.

Let us here pause for a moment to consider the results at which we have now arrived, and let us fully comprehend the purport of common and singular terms. We see that a common-term when applied to an object, merely indicates that it possesses certain properties which are shared in like manner by all the other constituents of a specified group. It is, therefore, evident that such a term or name belongs in reality not to an individual, but to a definite combination of qualities which are found in it. And the mode in which a common-term is obtained, is by comparing a number of separate objects, observing the points wherein they agree, combining these points of agreement into one idea, and then giving this combination a name, so that at any future time we may be able to recall the idea without having the trouble to go through the same operations again. Thus, for example, men observed the properties of many natural bodies, and finding that a certain number refused more or less to alter their volume or shape, the name of solidity was conferred upon this property; and, accordingly, whenever we hear the term "solid" applied to anything, we at once know that the body spoken of will resist a change either as to volume or shape. This process of combining various properties into one idea is called *abstraction*, and is the reverse of that previously described, namely *division;* for while the latter is al ogether occupied in discovering the points of difference between various notions, the former exclusively deals with the points of resemblance.

A singular-term is on the contrary employed to designate individuals instead of classes, and therefore is a mere arbi-

trary sign which conveys the notion of one single object. Such are all names of persons, rivers, cities, &c., and even common-terms may be converted into singular-terms by the employment of the demonstrative pronouns, as "this book," "that house," &c. &c.

There is yet another distinction of the members of a proposition, which it will be needful to notice. We have hitherto spoken of the subject and predicate together with the copula; now the two former are called the *terms*, as when a proposition is expressed in logical order they will form its respective boundaries or *terminations*, the copula occupying an intermediate position.

Of these terms it will be observed that there are three in each syllogism; two forming the subject and predicate of the conclusion, while the other is confined to the premises, in both of which it occurs. From these positions it is, that the names of the respective terms are derived; thus, the predicate of the conclusion is called the *major-term*, the subject of the conclusion is known as the *minor-term*, and the remaining term is characterised as being the *middle-term*. These names, too, are used to distinguish the premises, for that proposition which contains the major-term is called the major premiss, while the other, for a similar reason, is styled the minor premiss.

We are now in a condition to perceive clearly the full force of the train of reasoning which we chose in the first place as the subject of our analysis. In the first syllogism, we see that a middle-term, "radii of the same circle," is chosen, with which are respectively compared the major-term, "mutual equality," and the minor term, "A C and A B;" the result of this comparison being, that a certain relation, viz., "mutual equality," may be predicated of A C and A B. In the second syllogism, we have precisely the same major and middle terms, but a different minor-term, which, however, is found to bear a similar relation towards "mutual equality," as did the other minor, "A C and A B." The object then sought to be attained, is to show the equality of certain portions of the two minor-terms, and this is done by employing a fresh middle-term to serve as a means of connecting the idea of "equality"

with the notion "A C and B C." This middle-term is "things which are equal to the same thing," and when it has been properly applied, as in the third syllogism, we attain the desired result, viz., "A C and B C are equal to one another," or "A C is equal to B C."

Finally, let us recapitulate the information which we have acquired from our rapid survey of the extent of Logic. We find that it will be necessary to investigate, first the subject of notions or terms; next, the comparison of terms, or propositions; and finally, the deducing a conclusion from the juxtaposition of two propositions, or in other words, the nature and construction of syllogisms.

Necessarily this preliminary chapter has been somewhat discursive, and has but briefly sketched the more salient principles and branches of Logic. This glimpse of the path before him, however, as stated in the Introduction, will probably prove of great assistance to the student, for he will now proceed to a more detailed examination of the science, with a good notion of what he may expect to meet; a course which is surely preferable to that too often followed, whereby the learner is introduced at once to tedious technicalities, without the slightest idea as to where he will find himself at the end of his study.

CHAPTER II.

OF NOTIONS OR TERMS.

THE student is now about to descend into the plain, and to enter upon that road whose various windings and ultimate end he has recently surveyed from an eminence. Consequently he will for awhile lose sight of the goal, but as he is in a great measure acquainted with the general features of his course, he will not be dismayed if the path should not immediately appear to tend in the desired direction. And here I may mention that at first we shall proceed through a region abounding in hard names; but as the principal technicalities of the science have been already introduced, together with the principles upon which they are based, no difficulty will, I apprehend, be experienced in conquering what might otherwise prove a rather formidable array.

Our immediate subject is, of course, *notions* or *terms;* for we must obviously possess a certain number of ideas (logically, *terms*), before it would be possible for us to make any attempt whatever at a train of thought or reasoning. Accordingly, it might be considered necessary that I should in the first place examine the question as to whether ideas are coeval with the mind itself, or whether they are the results of experience: but, were I to do this, I should quit the domains of Logic for those of metaphysics. Suffice it, therefore, if I describe the manner in which we obtain *certainly many* of our ideas, and *possibly all.*

§ 1. *Simple-apprehension.*

When any object is presented to the mind, and the attention is directed to it, a certain mental impression is produced, unintelligible indeed as to its nature, but the result of which

is that the object is recognised when again observed. That is to say, an *idea* is formed in the mind of that combination of properties and appearances which revealed itself to the senses upon inspection. Such an idea is termed an *intuition*, or *singular-representation*, and evidently can only refer to an individual object. It is also necessary for purposes of intercommunication, that names should be given to these several intuitions, and these names are called *singular-terms;* such, for example, are, "London, France, Charles, Bucephalus."

Now it is evident that if a separate personal name were to be bestowed upon each object, great confusion would result; and as in the majority of cases it is by no means essential that, when speaking of an object, reference should be made to some particular individual, it would speedily be found necessary to assign certain *class-names*, under which a number of similar objects might be grouped. This, accordingly, is done in the following manner.

Suppose a great many individual books had come under our notice, and we wished to be able to recall at pleasure the general idea produced by any one of them, without, however, mentioning it by name. In the first place we should compare several together, and ascertain the points in which they resembled, and differed from each other; thus, we should perceive that some were illustrated and others not; that one related to biography, another to history, and a third to mathematics; that there were many gradations of size and bulk; that they were bound in various styles; but also that every one of them agreed in possessing certain definite properties. These properties we should then proceed to abstract or separate from those qualities wherein the volumes differed; and, combining the former into one idea, we should be able to conceive of a class of things, each member of which would contain in itself all those *marks* or *attributes* which we had selected as essential to the idea in question. Finally, we should apply some name, in the present case "book," to the class thus imagined, and in this manner we should accomplish the object with which we had set out.

The process which has here been described is that of abstraction; it will be seen to consist of five steps, viz., com-

parison, or placing several objects together in order to judge of their resemblance; reflection, by which we decide upon the properties in which they agree or differ; abstraction, which enables us to form the points of resemblance into one idea complete in itself; generalisation, or the conception of a class whose members shall each contain (*inter alia*) this compound idea; and denomination, by means of which we impose a name for the purpose of recalling to our remembrance both the class and the idea; the names thus imposed, being known as *common terms; e.g.*, "sea, river, mountain."

Into these two classes, then, viz., singular and common representations, may all our notions be divided; and as that action of the mind which merely consists of forming an idea is termed simple-apprehension, so it is said to be *incomplex*-apprehension when we receive a notion of individuals without observing any relation between them, or *complex*-apprehension, when we perceive the existence of a class.

§ 2. *Abstraction of Common-notions*

The faculty of abstraction is possibly the most active and powerful with which the human mind is endowed; far from remaining quiescent when it has succeeded in forming a common-notion (or *conception* as distinguished from *intuition*) by the comparison of separate individuals, it instantly proceeds to repeat the process on a larger scale. This is done by treating a number of *classes* as so many individuals, and then—when their points of resemblance have been noted and combined into one idea—forming a higher class, which will include amongst its members all the former classes. Nor need we stop even here, for it is evident that no limit exists to the number of repetitions of such a proceeding, unless indeed there be a limit to the exercise of imagination itself.

Now every science arranges the subjects upon which it treats, in a perfectly similar manner, this being based upon the results of abstraction: accordingly, logicians have devised a certain scheme of names for this system, which we shall now explain.

A single object is called an *individual*, and comprehends within itself two distinct sets of marks or attributes; these are; first, that combination of qualities which we abstracted to form the idea of a class, and, secondly, such attributes as remain. Each of the former is termed a *property*, whilst the latter are called *accidents* or *differences;* the class of which the individual is a member being known as a *species*. This species, which is merely composed of individuals, is called the *lowest* or *infima species*, and the next higher class, being founded upon a consideration of infimæ species, is termed a *genus:* the latter name, however, is only applied when we contrast the higher class with the lower, for in the next stage of our conceptions we come to a yet wider genus, of which the previous genus is only a species. Thus we go on until we arrive at the most comprehensive class of all, which is accordingly named the *highest* or *summum genus*, and this, of course, can never be a species, for there is no higher class to include it. Every other genus is called a *subaltern genus*, being alternately a species and a genus.

An example of the above method of arrangement may be given as follows:—

Individual	Iron.
Infima species . . .	Metal.
Subaltern genus . .	Elementary substance.
Summum genus . .	Matter.

Accordingly, we can say that iron is a kind of metal; that a metal is a species of elementary substance; that an elementary substance is a genus of which metals are a species, or that an elementary substance is a species of matter.

It is, of course, quite clear that the precise details of the system, such as the question of what are to be considered as individuals, or where abstraction is to cease, must be left to the arbitrary regulations of each science: the only point here insisted upon being the fact that this system is employed in every pursuit which engages the human mind, thus showing decisively that thought proceeds according to certain fixed laws; which laws it is the province of Logic to explain.

§ 3. *Predicables, Extension, and Intension.*

We have already stated that "predication" is the affirming or denying one thing of another; thus, when I say "A is B," I am said to predicate B affirmatively of A, but were I to state that "A is not B," I should predicate B negatively of A. Now those notions or terms which may be predicated affirmatively of others are called "*predicables*," and must necessarily include a greater number of objects than the subjects of which they are predicated.* Thus, a species may always be predicated of an individual, or a genus of a species; and therefore, in accordance with the above-given example, we may say "iron is a metal," or "metals are elementary substances," but not "metals are iron," or "elementary substances are metals."

It will here be seen that in legitimate propositions, the subject contains within itself not only the whole of the marks or attributes which collectively form the predicate, but also an additional series of qualities. For instance, "iron" contains the common-notion of a "metal," together with those peculiar marks which enable us to distinguish it from other metals: accordingly, there is a greater number of marks or attributes in the subject than in the predicate, and this kind of comprehensiveness is called the *intension* of a term. But, on the other hand, we see that the predicate embraces a much larger number of objects than the subject, as a "metal" not only includes everything that is "iron," but multitudes of other things besides, such as "gold, silver," &c.; and this species of capacity is known as the *extension* of a term. Consequently, a term used in extension comprises only the specific properties of a body; and as it is, therefore, more general and less distinctive, it may always be predicated of a term used in intension, which consists both of properties and of accidents.†

§ 4. *Division of a Common-notion.*

If we are desirous of completely understanding any subject, it is very necessary for us to examine it closely, and the

* Here, of course, I allude to common-terms, for a singular-term can never be predicated of anything but itself; *e.g.*, we can say "John is John," but not "a man (*i.e.*, every man) is John."

† See page 17.

mental process by which we perform this is what I shall now consider. It is, in logical language, termed *division*, and consists in viewing every general idea as composed of two main sections, viz., the several members or parts of the idea, and the tie which connects them together. We then place the various parts in regular symmetrical order, such as is best adapted to their mode of union, and thus we are enabled to study each object separately, both as regards its own individual features, and its relations to the other members of the system.

Now the "tie" or "mode of union" which has been here alluded to, is altogether arbitrary, and depends upon the purpose which we have in view when entering upon the study of any subject. Take, for example, the science of natural history: Aristotle, looking upon the blood as the grand basis of the phenomena of life, divided all animals into two great classes, one possessing colourless and the other red blood, which done, he proceeded to describe the individuals forming these classes; Cuvier, on the contrary, adopted the bony skeleton as his guide in the arrangement of the various forms of life; while Rymer Jones, Vogt, and Siebold have respectively chosen the nervous system, the phenomena of development, and the relative complexity of organisation, as keys wherewith to unlock the vast storehouse of nature.

But when we have in this manner set apart some portion of the subject as a general principle to which we must constantly adhere, it becomes necessary to separate the subject into as many parts as may be convenient. This is done by observing the marks in which one group or class of objects differs from another, and thus dividing the whole of the subject into a certain number of genera: each of these genera is then examined and similarly divided into lower genera; and so we go on until we can no longer discover any smaller groups in a class, but are compelled to enumerate the individuals of which it consists. Thus we arrive at a regular system of summum genus, subaltern genera, infima species, and individuals.

In order, however, that this process may be properly performed, logicians have laid down the following rules:—

1. The *whole* subject must be divided: that is to say, the various parts taken together must exactly equal the genus divided.
2. The division must be conducted according to some single, definite principle.
3. The parts must be quite distinct; no two containing any common object.

Thus, if we were studying architecture, and wished to obtain a correct idea of the class of objects which are termed buildings, we must discuss the whole of the subject, and not confine our attention to a few species, such as palaces and temples only. And then when commencing the division, we must proceed according to some settled principle, such as, for instance, "application," consistently with which we should form the different species of "private-dwelling-houses," "factories," "warehouses," "churches," &c., and therefore no confusion would result, for the third rule given above would remain uninfringed. But if we were to pursue a different plan, and to divide buildings indiscriminately into "palaces," "Doric," "Gothic," "prisons," &c., we should violate both of the latter rules, having employed two principles of division, viz., "style" and "application," in consequence of which the various classes would be intermingled, and no true division would be performed; for it is evident that some palaces might be Doric and others Gothic, &c. This error is termed *cross-division*, and is one of the most frequent sources of confusion and perplexity in discussion and argument.

§ 5. *Positive, Negative, and Privative Terms.*

In order to test a division as to whether it be perfect, logicians are accustomed to take each part separately, and examine the possibility of dividing the whole subject into *positive* and *privative* portions with reference to the selected part. Thus, suppose the subject "man" be divided according to the principle of "colour:" we should have the four species of "white-men," "black-men," "red-men," and "yellow-men." We then see that it is possible to also divide "man" into the two ideas or conceptions of "whitemen" and "non-whitemen," for black, red, and yellow may all be described as non-white.

In the same manner "man" may be divided into "black" and "non-black," "red" and "non-red," "yellow" and "non-yellow," and so at length we see that none of the classes intermingle with each other.

The term "white-men" is called *positive*, because it denotes that a certain view (white) is taken of the object (men), while the term "non-whitemen" is said to be *privative*, in consequence of its implying that such a view might be, and yet is not taken. If, on the other hand, it were impossible to form a certain notion of a subject, the term which implies this, such as, for instance, a "non-white negro," would be styled *negative*.

§ 6. *Definition.*

In the process of logical division it is evidently necessary that we should employ some means of precisely determining, first, the full extent of the subject to be divided, and then the respective capacities of the various parts or species: this we are enabled to do by the use of *definitions*, that is, certain expressions which describe an object or notion in such a manner that we are enabled to distinguish it from all others.

Now the act of forming these expressions is termed the process of definition, and consists in an enumeration of the various attributes composing a notion. As a notion, however, may be either singular or common, we are obliged to use two kinds of definition, one of which, *accidental-definition*, is applied to individuals, and consists of the specific name together with the accidents; while the other, *essential-definition*, being applied to classes, consists of the generic name, together with the specific difference. Thus, the Thames might be defined as "a river which flows through London," where "a river" is the name of the species, and "flowing through London" the accident which distinguishes the Thames from other rivers. Again, we may define light as "a species of motion affecting the optic nerves in such and such a manner," the genus being "motion," and "affecting the optic nerves" the difference which distinguishes light from other species of motion.

This latter kind of definition, consisting of the genus and

specific difference, is also termed *logical-definition*, in opposition to *physical-definition*, which enumerates such parts of the object as are *actually* separable: *e.g.*, the boiler, mechanism, &c., of a steam-engine. Some writers also include physical-definitions under the head of essential-definitions.

Various rules have from time to time been given by logicians for the purpose of securing correct definitions, and may be summed up as follows.

1. The definition must be of exactly the same extent as the object defined: that is to say, it must not be of too narrow or too wide an application. Thus, to define "gravity" as "a force which attracts bodies to the earth" would be too narrow, as not including the celestial attractions, and being only applicable to *terrestrial* gravity: to define it as "a force which attracts one body to another," would be too wide, in consequence of its including magnetic attraction, &c.

2. The definition must not contain anything beyond what is absolutely essential to the subject. For instance, it would be incorrect to say that a "man" is "an animal endowed with the faculty of speech *and with life*," as it might then be supposed that the existence of an animal with speech, but lifeless, was possible.

3. The definition must be plainer than its subject, and must not be a repetition of the same term: *e.g.*, the explanation that "a metal" is "a metallic substance," would be no definition at all, while to assert that it is "a product of Plutonic action" is equally unsatisfactory.

§ 7. *Names and their Divisions.*

We have already seen that when an idea or conception is gained of any object or class of objects, some name is immediately attached to it, for the purpose of recalling the impression at any future time. It now remains to describe the various species into which these names are divided for logical purposes.

1. Making a division according to logical quality, we find that all names or terms may be divided into *positive*, *privative*, and *negative*, which have been described above. Positive terms, however, are also called *definite*, from their distinctly

defining an object; while for the reverse reason privative and negative terms are styled *indefinite.*

2. Names, as regards the method of using them, are either *univocal*, *equivocal*, or *analogous;* that is to say, some have only one meaning, such as "book," "sofa;" others have several meanings, such as "light," which signifies either the contrary of "heavy," or a physical force; while others, again, are extended from one object to another in consequence of some similarity—thus, "tongue" may be applied either to the body or to a piece of land.

3. Viewed as to their mutual dependence, terms are *absolute* or *relative.* The former appellation is bestowed upon those terms which are considered by themselves as a whole; the latter belongs to those which form part of a more complex idea. For example, the term "man" would be absolute; while *plaintiff* would be relative, as being a portion only of the idea plaintiff-and-defendant. It will therefore be seen that relative terms exist in pairs, and cannot be applied to the same object, as then they would be what is called *opposite*, to distinguish them from *compatible* terms, as those are named which may be so applied.

Correlatives is a name given to each pair of relative terms, and implies their mutual connection.

4. Terms are either *concrete* or *abstract*, according as they imply a notion together with the object furnishing the notion, or the notion by itself. Thus "fluid" is a concrete, "fluidity" an abstract term.

Also when the terms employed are common terms, or the names of classes, a further distinction will be observed. Take, for example, the concrete term "fluid;" it is evident that there is here implied a substance possessing certain attributes; accordingly, such a term is called *attributive*, or *connotative*, because it *connotes* some attributes together with the object. Again, the abstract term "fluidity" is, in like manner, named *absolute*, or *non-connotative*, from its merely denoting an attribute and nothing beyond.

§ 8. *Opposition of Terms.*

There is said to be a *contradiction in terms*, or two terms

are said to be in *contradictory opposition* to one another, when the only difference between them consists in the respective presence and absence of a negative particle; this difference enabling us to apply them universally. Thus, everything must be either "living" or "not living," "red" or "not red," &c.

When, however, two terms differing as to the same idea cannot be both applied to the same object, and yet there are some objects to which neither can be applied, such terms are said to be in *contrary opposition* to one another: *e.g.*, a man is not at the same time "walking" and "running," but a tree does neither.

§ 9. *Structure of Terms.*

An idea or term is expressed by a word or words; thus, "man," "horse," "steam-engine," "the Emperor of Russia," and such words as can be used *alone* to represent a term, are called *categorematic;* while all others are denominated *syncategorematic.* Sometimes, however, we meet with a single word apparently filling the place of a term, but for which it is necessary to substitute some other expression before its full import is conveyed. Take, for example, the sentence "He loves;" this, if reduced to logical form, would be "He is a person who loves."

§ 10. *Conclusion and Recapitulation.*

We have now reached the end of our investigation into the first great division of Logic, and before we proceed any further, it will be well for us to cast a brief glance backwards, and fully comprehend the connection which exists between the subjects just discussed, and those to come.

The course, then, of our investigations has been first to analyse the method in which we gain and record the impressions or ideas produced by the various objects which attract our attention: in doing this we found that all our ideas are either of individuals or of classes, the former being the result of incomplex-apprehension, the latter of complex-apprehension, which consists of the five processes of comparison, reflection, abstraction, generalisation, and deno-

mination. In the next place we examined the mode of arranging and classifying our ideas by the abstraction and division of conceptions (common-notions): this led us to perceive that the subject of a proposition embraces more marks or attributes than the predicate, while the predicate comprehends a greater number of objects; that is to say, the subject has the greater intension, the predicate the greater extension. We then showed how a logical division might be tested by the use of positive and privative terms, which done, it became our duty to describe the process of definition, and to explain the various rules which have been laid down for the purpose of securing correct results. Finally, we enumerated the divisions of the various names which have been bestowed upon ideas, and concluded by noticing the opposition and structure of terms.

It will of course be understood that in order to form an idea, it is not necessary that a tangible, corporeal object should be presented to the senses, for we have many notions to which there exists no corresponding reality: such, for example, are our ideas of justice, honesty, &c. In fact it may be said that no common-notion whatever has any existence out of our own minds; the conception of "man" for instance being merely that of a combination of marks or attributes which are never found separately by themselves, but are always united to other objects. Thus it is certainly true that the idea "*man*" has no *isolated* existence, but still it cannot be denied to *exist*, simply because it does so in conjunction with something else.

This question, here touched upon, is the celebrated bone of contention between the schools of the nominalists and the realists, the former following Abelard, and denying that common-notions (or universals) are anything more than mere names, while the latter, under the guidance of Plato, strongly affirmed the reality of their existence. The days of the schoolmen was the time when this controversy grew most warm, and such was the importance attached to the subject, that kings and popes did not scruple to exert their utmost power in the attempt to secure the triumph of the sect which they respectively patronised. But this by the way.

Now when the mind has once become supplied with ideas, it is enabled to reflect, the result of which is the formation of certain judgments. These judgments, when formally stated, are termed in logical language *propositions;* and, accordingly, the subject of our next chapter will be an examination of their origin and nature.

CHAPTER III.

OF JUDGMENTS OR PROPOSITIONS.

§ 1. *Formation of Judgments.*

Judgment is the act of determining by comparison whether one idea is or is not included within another; that is to say, it ascertains whether an individual belongs to a certain species, or a species to some genus. Archbishop Thomson has defined it as "an attempt to reduce to unity two cognitions." He says, "When one decides that 'Socrates is wise,' it is that hereafter one may, by combining the two notions, think of 'the wise Socrates.'" Now it is by no means evident that the two cognitions are here attempted to be reduced to *unity*, for no person would surely expect to render them so inseparable, that whenever the idea of "wisdom" presented itself to his mind it should be invariably accompanied by the notion of "Socrates." In fact the judgment that "Socrates is wise," is merely an assertion that "Socrates belongs to the class or species of wise men," or "Socrates possesses wisdom," thus enabling us to fix his place more exactly in our system of ideas.*

Accordingly, it will be seen that judgment is the result of that mental faculty which so strongly impels us to classify and arrange the various notions with which our senses provide us, so that we may the more clearly comprehend the various dependencies and relations by which they are connected together into one harmonious whole. We have already considered three portions of this faculty, viz., abstraction, division, and definition; it now remains to consider judgment, without which none of these processes could be conducted.

* For further information upon this point, see Appendix A.

And here it might well be asked whether, if the formation of common-notions is the result of judgment, a judgment also in its turn is not the result of reasoning—for we have already seen that the conclusion of a syllogism is a judgment or proposition. This question, however, belonging as it does to metaphysics, cannot be satisfactorily answered in the present place; and, therefore, I shall at once proceed to discuss the nature and *proximate* origin of propositions, without minutely investigating their remote ancestry.

§ 2. *Categorical Propositions.*

A categorical judgment or proposition is an assertion that one idea agrees or disagrees with another, and consists of three parts—the *subject* or idea under examination; the *predicate*, or idea to which the subject is referred; and the *copula*, which determines the relation between them. Thus, in the proposition "lions are animals," the subject is "lions," and is connected to the predicate "animals," by the copula "are," which implies that "lions" form a species of the genus "animal." This judgment results from our having compared the two ideas with a view to ascertain whether the attributes of "animal" were contained in "lion."

The subject and predicate of a proposition, may of course be infinitely varied, since there is no limit to the number of ideas; but the copula always remains the same, being either "is," or "is not," or their equivalents. And here it may be remarked that the word "is" signifies, when employed in a proposition, the *identicality* of the subject and predicate, such *identicality* being, however, *limited* by the form of the proposition. The subject and predicate are also called the terms of the proposition, as they form its boundaries or terminations.

Categorical propositions are divided into *pure* and *modal*—the former being cases where the subject is *directly* asserted to agree or disagree with the predicate; the latter where the subject is said to agree or disagree with the predicate *in some particular manner*. For instance, "The sea is rough;" "He addressed the people;" are both pure, but "The sea is terribly rough;" "He addressed the people good humouredly;" are modal. This distinction is, however, of no use for logical pur-

poses, since we may always treat modal propositions as being pure, by simply attaching the *mode* to either the subject or the predicate: thus, in the example above given, "terribly rough" must be taken for the predicate.

§ 3. *Hypothetical or Conditional Propositions.*

All judgments are not formed by a comparison of existing notions, for it is possible to decide upon the mutual relation of two assumed conditions of things. Accordingly, we meet with a class of propositions termed *hypothetical*, or *conditional*, whose assertions are subject to a certain *condition:* of this kind are such sentences as the following—"If the results of geological science are trustworthy, the earth has existed for countless ages." "If you do this well, you shall be rewarded."

Hypothetical propositions are not, however, to be considered as different in nature from categoricals, for both species of judgment result from precisely the same operation of the mind. This will be clearly seen if we examine one of the instances given above, and ascertain what it is that we really assert. Taking the first example, it is evident that we decide nothing as to the results of geological science, or as to the earth, but we say that the assuming those results to be trustworthy would necessitate our granting the earth to be of the age stated. This judgment, then, may be expressed as follows, viz., "The case or supposition of the results of geological science being trustworthy, is a case or supposition of the earth having existed for countless ages"—where the subject, copula, and predicate of a categorical proposition will be at once recognised.

§ 4. *Disjunctive or Alternative Propositions.*

There is yet another form which our judgments may assume, this being the statement of some alternative, such as, "Either Tyndall is wrong, or mechanical force produces heat;"—which, accordingly, is known as a *disjunctive* or *alternative* proposition. To show its harmony with the forms already discussed, we have only to remark that it may be converted at will into a hypothetical, as, "If Tyndall is not

wrong, mechanical force produces heat;"—or into a categorical, thus : "The case of Tyndall being wrong, and the case of mechanical force producing heat, are all the cases possible."

As regards hypotheticals and disjunctives considered apart from categoricals, we shall have more to say when we come to discuss the treatment of arguments where they occur ; at present, however, we are concerned altogether with pure categoricals, having shown that all propositions whatever may be regarded as such.

§ 5. *Quantity of Propositions.*

As we have no ideas beyond those of individuals and of classes, our judgments must always be concerning intuitions (singular-notions), or conceptions (common-notions). Now a singular-notion being indivisible, we must invariably treat of the whole of it; but as regards common-notions, we are able to discuss either a part or the whole. This distinction has enabled logicians to divide all propositions according to *quantity;* that is to say, according to the extent of their subjects : and, therefore, whenever the subject is a singular-notion, as, "John is rich,"—or the whole of a common-notion, as, "*All* metals are conductors of heat,"—the proposition is called *universal;* but if only part of a common-notion be employed for a subject, as, "*Some* metals are lighter than water," then it is termed *particular.*

§ 6. *Quality of Propositions.*

Another division of propositions is according to the signification of the copula, which is termed the *quality* of a judgment, and as this must be either affirmation or negation ("is" or "is not"), so propositions are styled *affirmative* or *negative,* according as they respectively express the agreement or disagreement of subject and predicate. Thus, "The whale is a mammifer" is an affirmative proposition ; while "No alloy of ammonium is stable" is negative.

It must here be remarked that a negative sign may occur in a proposition, and yet not belong to the copula ; in such a case the proposition is affirmative. Take, for example, this

judgment, "Not to accept the offer is great folly," and we see that the "non-acceptance" and "great folly" are declared to agree with each other.

§ 7. *Distribution of Terms.*

Whenever in a judgment a term is used in its full sense—that is to say, as comprehending every single object that it could possibly include—it is said to be *distributed:* accordingly, every universal proposition distributes its subject, but particulars do not. When, however, we examine into the distribution or non-distribution of the predicate, we find that this depends not on the quantity, but upon the *quality* of the proposition. Thus in negative judgments it will be seen that the *whole* of the predicate is declared to disagree with the subject; as, for instance, in the following proposition, "No negro kingdom is civilised," where the entire idea of "civilisation" is pronounced to be incompatible with the idea of "negro kingdoms." But in affirmative judgments the case is different, as we can only infer from the form of the expression, that a *part* of the predicate is implied. Thus, knowing that one *portion* of the genus "animal" is composed of "horses," or in other words, that the attributes forming the idea of "animal" is to be found in every horse, we can say correctly that "horses are animals." Here, then, the predicate is not distributed.

Consequently, we arrive at these two rules:—

1. The subject is distributed in universal, but not in particular propositions.
2. The predicate is distributed in negative, but not in affirmative propositions.

The latter rule is, however, subject to three exceptions; first, when in an affirmative proposition the predicate is a singular notion and is consequently distributed, for we cannot think of a part only of an *intuition;* secondly, when some expression is employed which indicates that the *whole* of the common-notion forming the predicate is compared with the subject. Thus, in both of the propositions, "Davy was the discoverer of potassium," and "These fragments are all that

remain,"—the predicate is distributed. The third exception is to be found in negative propositions, where the predicate is qualified in such a manner as to indicate that *part* only of its signification is employed. This will be observed in such sentences as " Steam-engines are not *some* machines ;" " No men are *some* created beings ;"—which import respectively that some machines are not steam-engines, and that some created beings are not men. These latter propositions are termed *partial-negatives*, those to which the rule applies being styled *total-negatives*.

§ 8. *Relation of Terms.*

We have already stated that judgment is the act of determining by comparison, whether one idea is or is not included within another. In doing this we find some cases where the notions are of equal extent, such as the various intuitions produced by the same object under different circumstances, or those conceptions which comprise the same individuals. This fact we express in the *form* of the proposition, which consequently indicates that it is the result as it were of *two* judgments, the one having ascertained that the subject of thought belonged to a certain class, while the other determined that it was co-extensive with the class. Such propositions are those mentioned above as constituting exceptions to the rule which declares that no affirmative proposition distributes the predicate.

Now in consequence of this relation, it follows that we may indifferently affirm the predicate of the subject, or the subject of the predicate. Thus it matters not whether we say " Davy was the discoverer of potassium," or " The discoverer of potassium was Davy ;" or again, whether we say, " These fragments are all (the fragments) that remain," or " All the fragments that remain are these (fragments)." Accordingly, such propositions are termed *substitutive*, from our being able to employ subject and predicate as substitutes for each other.

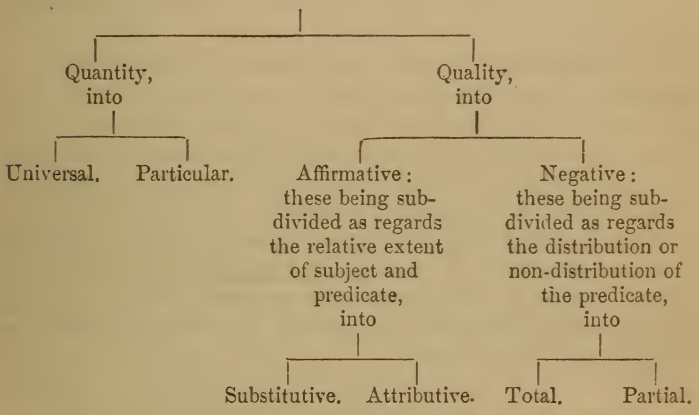
All other affirmative propositions have their predicates non-distributed, and merely import that these may be attributed to, and not substituted for, the subjects. On this account they are styled *attributive*.

§ 9. *Systematic Classification of Propositions.*

Having now given a full description of the various divisions and subdivisions of propositions, it will be well to give a short summary of the system. This is best done by the use of a "scheme," as follows :—

Propositions

regarded logically, *i.e.* with reference to their form, are divided according to



§ 10. *Table of Possible Propositions.*

We see by the above scheme, that propositions are of four great classes, affirmative-substitutive, affirmative-attributive, total-negative, and partial-negative. Each of these may be again subdivided into universal and particular, so that altogether there are eight possible kinds of judgment or predication. The names of these propositions, however, being too long and cumbersome for constant repetition, logicians have adopted certain letters to serve as symbols for these names, and in the following table will be found a list of all possible propositions, together with their respective symbols, and illustrative judgments ; the subject and predicate in each being represented by the letters X and Y.

Name.	Example.	Symbol.
Univ. Affirm. Substi.	All X is all Y.	U.
Univ. Affirm. Attrib.	All X is some Y.	A.
Univ. Total Neg.	No X is Y.	E.
Univ. Partial Neg.	No X is some Y.	η.
Part. Affirm. Substi.	Some X is all Y.	Y.
Part. Affirm. Attrib.	Some X is some Y.	I.
Part. Total Neg.	Some X is no Y.	O.
Part. Partial Neg.	Some X is not some Y.	ω.

In this table there are two propositions which, as being of little practical importance, we may leave out of our future consideration. I allude to those whose symbols are η and ω; the reason of their inutility being as follows. When we say "no men are some animals" (η), we mean "some animals are not men" (O), which latter, being a much more forcible and convenient mode of expression, is usually adopted. Also when we say "some men are not some animals" (ω), the power of negation is still less, for there is nothing to prevent us saying at the same time "some men *are* some animals."

Accordingly, I shall confine my future remarks to the six kinds of judgment, U, A, E, Y, I, and O, and when the student is able to treat arguments involving these, he will find very little difficulty in disposing of those rare cases in which η and ω may occur.

§ 11. *Interpretation of the Copula.*

The copula, as already stated (§ 2), signifies a certain identicality of the subject and predicate. This identicality, however, may be considered from several points of view, according to the purpose we have in hand. Thus, if we were engaged in determining the intension of the notion "fluids," *i.e.* in ascertaining what were its marks or attributes, and we were to form this judgment, "All fluids are compressible," we should mean that fluids were contained in the class of compressible substances, *in virtue of one of their attributes being compressibility*. But if we were chiefly desirous to fix the relative extent of the terms, *i.e.* to determine their extension, we should only care to imply by the above expression that *the class of compressible substances included amongst other things the class of fluids.*

It will, however, be observed that these are not two *different meanings* of the proposition, but merely *two different modes of regarding the same meaning.*

Another method of interpreting the copula, or connection between subject and predicate, has been suggested. This consists in viewing the judgment as regards its *denomination, i.e.* in considering it as implying that the predicate may be given as a name to each of the objects contained in the subject. The example stated above, if interpreted in this manner, would be held to imply that the name "compressible" might be given to every fluid.

§ 12. *On some other Properties of Judgments.*

It is impossible for us to form a *complete* idea of any object, as we are unable ever to ascertain the whole of its various marks or attributes. Accordingly, we observe continually some new feature, and this it is which causes us to make so many fresh judgments. At the same time there always exists a certain set of marks which are almost inseparably connected in our minds with respective ideas; so that it is scarcely possible to recall these ideas without at the same time recalling those attributes. Take, for example, the case of material bodies; we cannot think of any, without also thinking of shape and extension, two properties of matter.

Upon these considerations, metaphysicians, and after them, logicians, are occasionally accustomed to consider judgments with reference to their bearing upon our knowledge of the subject. If they increase our information, such as those which result from our discovery of some new attribute, they are termed *ampliative.* If they add nothing to what we really know, they are called *explicative* when they are in a measure explanatory of the subject by predicating some closely-connected attribute; or *tautologous,* when the predicate is identical with the subject, such as, "A man's a man."

§ 13. *Concluding Remarks.*

In the present chapter we have taken the subject of "judgments," for logical investigation, and the result of our studies may be summarised as follows.

Judgment is the act of determining the agreement or disagreement of two notions, and when its result is expressed in words, it forms a sentence which is termed a proposition. Propositions may be stated categorically, such as "A is B," or "A is probably B," the former being *pure*, the latter *modal:* hypothetically, such as "if A is B, C is D:" or disjunctively, such as "either A is B, or C is D." All propositions may, however, be reduced at pleasure to a pure categorical form. Accordingly, in a systematic account of judgments, reference is made exclusively to pure categoricals, concerning which there are four great doctrines. The first is of quantity, and divides all propositions into universal or particular, according to the respective extent of their subjects. The second is of quality, and divides all propositions into affirmative or negative, according to the import of their copulæ. The third is of distribution, and determines in what cases the various terms are employed as wholes or parts, *i.e.*, whether they are distributed or non-distributed. The fourth is of relation, and arranges all propositions according to the extent of their predicates; affirmatives being divided into substitutives and attributives, and negatives into total and partial. From this classification it results that there are eight different kinds of propositions, each being for the convenience of logicians distinguished by an arbitrary symbol. Two, however, of these species may be dispensed with as being of little practical importance; and, therefore, only the remaining six need be dwelt upon in future. Judgments may also be viewed as regards the significance of their import, which varies with the method of interpretation. Thus, they may be considered with reference to their intension, or attributes of the subject; extension or relative capacity of the predicate; denomination, or applying the predicate as a name to each member of the subject; or, finally, with reference to their bearing upon our knowledge, according to which they are ampliative, or informing; explicative, or explanatory; tautologous, or useless.

We are, therefore, now in a position to enter upon the investigation of a most important and interesting topic—the formation of new judgments from a consideration of some

already existent. This process, termed reasoning, is as it were, the very climax of logical science, and illustrates the use of our preceding reflections upon terms and judgments. Its study is, however, far from being difficult when orderly arranged, and is calculated to induce the most pleasing emotions in the mind of any person who has attentively pursued it, and has observed the singular simplicity and harmony with which the mind works. In fact, we have already had some remarkable instances of this, for we have discovered that the vast, nay infinite world of ideas—than which nothing can be more varied and diverse—may be referred to a few simple processes of the intellect, and may be grouped together into a system of surprising lucidity. The same thing occurs with our innumerable judgments, which, though outwardly dissimilar and confused, are found to be all constructed on the same plan, and to be capable of arrangement in orderly sequence and regularity.

Accordingly, to him who zealously strives after a complete understanding of these facts, there accrues an elevation of the mind such as cannot otherwise be attained. That grand principle of systematic grouping which underlies all his capacities of acquiring knowledge, is roused into vigorous and healthy exercise; his powers of observation, or rather, his capabilities of impression by outward objects, are greatly increased; and, while he is charmed by the stately vista of theoretical truth which reveals itself before him, he is at the same time conscious that his toils have not been unfruitful in practical results.

CHAPTER IV.

OF REASONING OR ARGUMENT. SYLLOGISMS.

§ 1. *Reasoning in General.*

The desire of the mind for knowledge admits of no satiety: vast though its acquisitions may be, the pursuit is in nowise slackened; and the regions of infinity itself oft yield rich spoils to some aspiring intellect, which, thirsting for new worlds to conquer, has striven to investigate the most mysterious recesses of the universe. This fact is proclaimed in every page of the world's history: the speculations of the philosopher, the actions of the statesman, the harmonious breathings of the poet, all alike bear witness that the watch-word "progress" is stamped indelibly upon the human mind. If, then, we consider that in our souls there is implanted a faculty which irresistibly carries us forward to the acquirement of new truths, we shall not be surprised when we discover that there are also implanted certain natural laws, which serve to control and guide that faculty in the manner best adapted for the attainment of its ends. Accordingly, since these laws exist, and are the same in all minds, it results that the method of acquiring knowledge is identical in every case.

Now, information may be obtained in three different ways: by the presentment to our minds of the various objects of thought, thus inducing the formation of ideas; by the comparison of ideas, which enables us to make judgments; and by the comparison of judgments for the purpose of arriving at some new truth. The two former of these processes have hitherto engaged our attention exclusively; we have therefore now to investigate the latter, which, of all the mind's

actions, challenges our observation in the most marked manner.

Reasoning, then, consists in arriving at some new truth, from a consideration of other truths already established. These truths it is evident may be expressed in numberless ways, as also may the truth to be inferred; but whenever an act of reasoning is put into words, it will always be found possible to separate it into two portions, one expressing some admitted truths, the other some truth resulting from them. Thus the mere arrangement of the argument (as an act of reasoning when expressed in words is termed) matters nothing with regard to the principles involved; and, consequently, in spite of these principles being, as above stated, universal, we everywhere find that reasoning is expressed in whatever manner may be suggested by the circumstances of the case. This it is, which has led to such erroneous opinions as to the true office and nature of Logic; men, distinguished in other respects for their prodigious intellectual power (*e.g.* Locke), having imagined that because Logic alters the loose, popular *arrangement* of arguments, into a form better adapted for elucidating the principles concerned, it therefore is occupied in teaching some particular *method* of reasoning, the laws of which are different to those employed by such as have not studied the science.

§ 2. *Syllogisms. Inference.*

From the preceding remarks it will have been gathered that before entering upon a logical investigation of any act of reasoning, it is necessary that this should be expressed in a certain regular form. Such forms are termed *syllogisms*, and are so constructed as to show the validity of the argument, without any reference to its *matter*, *i.e.*, to the subjects of which it treats: that is to say, the mere manner of expression is such that the new truth, or *conclusion*, is at once seen to be legitimately deduced from the truths already granted, viz., the *premises*.

The act of thus deducing the conclusion from the premises is termed inference, and consists in ascertaining the full purport of the premises. Thus, ascertaining that chlorine is a

gas, and knowing that all gases are elastic, I infer, or conclude that chlorine is elastic. If expressed in logical form, the argument would run thus: "All gases are elastic; chlorine is a gas; therefore chlorine is elastic." It is not, however, always the case that we commence our reflections with the premises, for we frequently first consider the conclusion, under the guise of a question or problem. For instance, suppose in the above case that we wished to know whether chlorine was elastic or not: we might ascertain the truth by examining the substance; and, finding it to be a gas, we should be certain that it was elastic, as previous investigations had decided that all gases were so. Here we see that there are two terms, "chlorine," and "elastic," the agreement or disagreement of which, we were enabled to decide upon by finding some third term, "gas," wherewith they might be respectively compared. This third term is called the *middle* term, and is the very essence of the syllogism; the inference connected with it being accordingly termed syllogistic, or *mediate* inference.

We now arrive at a somewhat interesting question, viz., whether there can be any kind of reasoning other than mediate inference; that is to say, can we from *one* judgment or truth only, *directly* infer some other? Some writers have contended that such a thing is possible, and have accordingly described a species of reasoning which they term *immediate* inference. Others have denied the possibility of this, and assert that in the examples adduced by their opponents, there is no inference or reasoning whatever.

Now the truth would appear to be that the disputed cases are in reality certain examples of *mediate* inference, which possess such strongly marked peculiarities as to distinguish them from all other instances of reasoning, and to lead to the belief that the laws upon which they are constructed differ from those of the regular syllogism.

It will, therefore, be well to consider these arguments apart from the great bulk of reasonings, more especially as owing to the above mentioned views being adopted, logicians have devised rules for the treatment of such cases, to which rules both parties agree. The arguments themselves may be

classed under three great heads or doctrines, viz., *opposition*, *conversion*, and *coincident junction:* these I shall now proceed to investigate, showing in each case the real nature of the argument.

§ 3. *Opposition.*

The relation which exists between any two propositions differing in form, but identical in matter, is termed opposition. Thus, the judgments "All fishes swim," and "No fishes swim," agree as regards their matter, *i.e.*, their subjects and predicates are respectively formed by the same notions; but they differ with respect to form, one being A, or universal-affirmative-attributive, while the other is E, or universal-total-negative: they are accordingly said to be opposed. And here it should be remarked, that in order for opposition to exist, the respective subjects and predicates must, in both propositions, be considered with reference to the same ideas, time, and circumstances. Thus, I might say, "This man is happy," and "This man is not happy," with perfect truth, providing I were alluding to his condition at separate times; but otherwise, the judgments would be opposed to each other.

The doctrine of opposition is based upon an examination of the various forms of propositions, and declares the natural laws which regulate their mutual relations. Take, for example, a proposition in E, "No metals are vaporisable." On analysing this, we arrive at the following results: that the proposition asserts the total exclusion of the class "metals" from the class of "vaporisable substances;" that—since from the nature of things we know there must always be either a total exclusion, or partial inclusion at least of one class in another—accordingly, if the proposition be true, any judgment which asserted an inclusion (even if only partial) of "metals" within "vaporisable substances," would be false; while if the proposition were not true, a judgment of partial inclusion, at any rate, must be correct. The rule, then, that we should deduce from such an examination would be, "Either E or I must be true;" this, when required for formal use, being converted into its equivalent categorical propositions, "The case of E being false, is a case of I being true;" and "the case of I being false,

is a case of E being true." Taking the example given above, we have for the complete syllogism,

The case of E being false is a case of I being true,
The present is a case of E ("no metals are vaporisable") being false;
∴ The present is a case of I ("Some metals are vaporisable") being true.

In logical language, when we assert the truth of any proposition, we are said to *posit* it; when we deny its truth, we *remove* it. Consequently the above rule is thus technically expressed, "From the position of E we may infer the removal of I; from the removal of E we may infer the position of I; and, in both cases, *vice versâ*." The relation thus declared to subsist between E and I, is called contradictory-opposition, and E and I are termed the contradictories of each other.

I have now I trust shown, once for all, that the inference which obtains in cases of opposition, is *mediate*, and may be regularly expressed in the syllogistic form. I shall, therefore, in recounting the remaining kinds of opposition, merely give the usual logical rules for the position and removal of propositions, without discussing their bases, as the student will be able to do this for himself, by following the method of procedure adopted above.*

There are four kinds of opposition: contradictory, contrary, subaltern, and subcontrary.

Contradictory opposition exists only between E and I, although those writers who do not recognise U and Y, describe it as also existing between A and O. The rule of this opposition is, "The position of a judgment infers the removal of its contradictory; the removal of a judgment infers the position of its contradictory." It has been fully explained above.

Contrary opposition exists between those pairs of judgments which may be false together, but cannot at the same time be true. These are A and E, A and U, A and O, A and Y, U and Y, U and O, E and U, and E and Y. The rule is, "The position of a judgment infers the removal of its contrary." Nothing, however, follows from the removal of a judgment. Thus, "All whales are warm-blooded," and "Some

* For further remarks upon this subject see Appendix B.

whales are not warm-blooded," are contraries (A and O): if we admit the former, we must deny the latter, but if we deny the latter, we are in doubt whether to say, "All whales are all the warm-blooded (things)" (U), or, "All whales are (some) warm-blooded" (A).

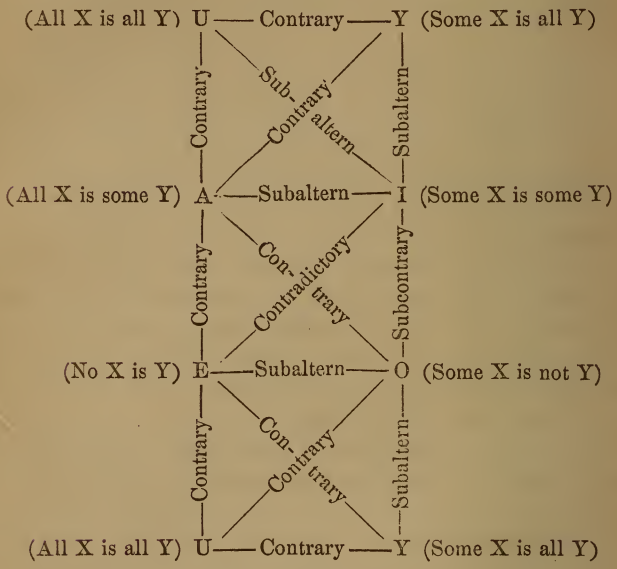
Subaltern opposition exists between certain pairs of judgments which may be true or false together, viz., A and I, U and I, Y and I, E and O, and Y and O. In these cases, that judgment which has most distribution in its terms is called the *subalternant*, its opposite being styled the *subalternate*. Thus I is subalternate to A, U, and Y, while O is so to E and Y. The rule here is that, "The position of the subalternant infers the position of the subalternate."

Subcontrary opposition exists between I and O, which may be true, but cannot be false together; accordingly, the rule in this case is, "The removal of a judgment infers the position of its subcontrary." Y and O have been termed subcontraries by Dr. Thomson, but they would rather appear to come under the head of subaltern opposition, where it will be observed that I have placed them.

It is proper to remark here that the word opposition does not in logical language imply an *incongruity* of two judgments, for we have just seen that there are some cases where opposed propositions may both be true at the same time; it is merely a name given to a certain *relation* existing between the various *forms* of judgments, such relation differentiating as the forms themselves differentiate. Therefore, when Sir William Hamilton states* that "there is no opposition between subcontraries," and that to say so "is a mistake," he appears to have been misled by grafting the ordinary sense of the word "opposition" upon its logical signification; for at a short distance previously we find him declaring opposition to be a relation existing between two judgments which are "opposed or *conflictive*." It is, however, somewhat strange that he should omit to take any notice of subaltern opposition as such, and content himself with merely mentioning it as a relation of subordination. He, it will thus be seen, admits of only two kinds of opposition—contradiction and contrariety.

* "Lectures on Logic," vol. i. p. 261.

It is generally the practice in logical works to give a figure or "scheme" of opposition; and, as this plan is useful in many respects, I subjoin the following, which shows at a glance the relations that have been described above as existing between the various forms of propositions.



§ 4. *Conversion.*

Conversion is the technical name applied to the operation of forming one judgment from another in such a manner that the subject and predicate of the original proposition (the *convertend*) shall be respectively the predicate and subject of the new one (the *converse*). Thus, "Some men of great imagination are all the good poets," is said to be the *converse* of "All good poets are men of great imagination."

Now it is evident that a process of inference takes place here :* let us, therefore, inquire into its nature.

The import of our first judgment is that the class of "good poets" is included, amongst other things, in the class

* See Appendix B.

of "men of great imagination;" and as we know from the natural laws of extension that when one thing is included in another, a part of the object including is equal to the whole of the object included,—we therefore see that in the present case it will be allowable to predicate the entire class of good poets," of "*some* men of great imagination." Accordingly, we frame a general judgment which may be applicable to all cases, and which runs thus, "A case of A is the case of the same subject and predicate being reversed and thrown into the form of Y."

The syllogism, then, will be as follows :—

A case of A is a case of Y containing the same terms as A, but reversed in position,

The present case ("all good poets," &c.) is a case of A ;

∴ The present case is a case of "some men of great imagination are all good poets."

The general practice, however, with regard to conversion is the same as that pursued in reference to opposition : instead of framing a syllogism every time we wish to convert a proposition, we employ certain rules which enable us to perform the operation in a more speedy manner. These rules are :—

1. The quality of the converse must be the same as that of the convertend.
2. No terms must be distributed in the converse, but such as are distributed in the convertend.

If the above rules be adhered to, no difficulty need be experienced in converting any proposition whatever ; but as a means of facilitating the process still more, the following table will be found useful.

U	may	be	converted	into U
A	,,	,,	,,	Y
E	,,	,,	,,	E
Y	,,	,,	,,	A
I	,,	,,	,,	I
O	,,	,,	,,	η
η	,,	,,	,,	O

One peculiarity of this table will be at once noticed by the student : I allude to the employment of the form η. This is necessitated by the consideration that if we follow the rules

just given, we can only convert O into η; it is, however, a conversion which is never likely to be made, for, as stated in a former part of this work (p. 34), O is "a much more forcible and convenient mode of expression" than η.

The above method of conversion may be termed *simple*-conversion, although this name is usually limited to the conversion of E and I; that of A being called conversion *per accidens*, or *by limitation*, in consequence of a particular proposition being educed from a universal; while O is treated as inconvertible.*

There is another process which is sometimes considered as a species of conversion, and which may well be examined in the present place. It is variously termed conversion by *equipollence*, by *contraposition*, by *negation*,† by *double negation*,‡ and *immediate inference by means of privative conceptions*; § the name which I shall employ will be *privative-conversion*, as this both indicates the nature of the process, and is harmoniously opposed to the term *simple conversion*.

The *modus operandi* of privative-conversion consists in changing the quality of the convertend, and altering its predicate into a corresponding positive or privative conception, according as the case may be. The reasoning process which forms the foundation of the doctrine is as follows. Take some proposition in A, as, "All intellectual men are amiable," and let us think what it is that we know about its terms: the judgment itself makes us aware that "intellectual men" are in the class of "amiable men," but gives us no further information regarding the latter class; we know, however,¶ that it is possible to form a conception which shall include every man not comprised under "amiable men," and that then we may deny the latter of the former: this we proceed to do, and say, "No amiable men are unamiable"—a judgment which supplies us with the desired premiss, and enables us to form a complete syllogism; thus:—

* Here it will be seen that I allude to those writers who only admit A, E, I, and O.

† Whately's "Elements," Book ii. chap. ii. § 4.

‡ Hamilton's "Logic," vol. ii. Appendix V. c. p. 267.

§ Thomson's "Outlines," § 86. ¶ Supra, p. 20.

No amiable men are unamiable,
All intellectual men are amiable;
∴ No intellectual men are unamiable.

This conclusion is the converse required, and is seen to fulfil all the conditions of privative-conversion; that is, its quality is changed, and its predicate is replaced by a corresponding privative-conception.

§ 5. *Coincident Junction.*

When one class is said to be comprised in another we mean that all the members of the former are also members of the latter. Accordingly, these members may be considered as objects which (*inter alia*) are composed of two sets of ideas inseparably connected. We cannot, therefore, add anything to one idea and not at the same time add it to the other: nor for the same reason can we add one of the ideas to anything, without also adding the other. These considerations supply the general principles of what may be termed the doctrine of *coincident-junction*, and which is thus expressed: "From any judgment we may form another by adding some marks equally to the subject and to the predicate; or we may add the subject and predicate as marks to some fresh conception." Thus if "a metal is a solid" be true, we may also infer that "a red metal is a red solid;" or if we admit that "Logic is the science of the laws of thought," we must equally admit that "the study of Logic is the study of the science of the laws of thought." The former of these inferences has been termed "immediate inference by added determinants;" the latter, "immediate inference by complex conceptions." It will, however, be readily seen from the above investigation of the principles involved, that these reasonings may be exhibited in the syllogistic form, as easily as any of the others.

This concludes the discussion of those arguments which are commonly styled immediate inferences; and, accordingly, whenever we have occasion to employ them in any future portion of this work, they will be considered as falling under their own special rules, and not as regular syllogisms. Such a course will be the more convenient as it will be more familiar to the student; for the general laws which constitute the third

propositions of such syllogisms as have been already considered, are so firmly fixed in our minds, that we are scarcely conscious of their existence, until our attention is specially directed to them; and, consequently, it may almost be said that they are never *overtly* employed in the eduction of so-called immediate inferences.

It will of course be understood that these arguments are not limited to a single operation; for it is possible to start with a judgment and successively employ the three processes of opposition, conversion, and coincident-junction, until we arrive at some other proposition which may satisfy our requirements. Such a proceeding is sometimes said to be merely a determination of a proposition's full signification; but this may be said in effect of all reasoning whatever, for "an *extension* of any science through Logic is absolutely impossible; as by conforming to logical canons we acquire no knowledge, receive nothing new, but are only enabled to render what is already obtained, more intelligible by analysis and arrangement."*

§ 6. *Mediate Inference formally expressed as such.—Its Divisions.*

When an act of reasoning is fully expressed in words, *i.e.*, if the three judgments be articulately stated, we have what is termed a syllogism. But as we saw, when treating upon propositions, that these are of three kinds, categorical, conditional, and disjunctive; so in like manner are syllogisms divided, according as they contain these respectively. Thus the syllogism, "All A is B; C is A; therefore C is B," is *categorical;* "If A is B, C is D; A is B; therefore C is D," is *conditional;* and, "Either A is B, or C is D; A is not B; therefore C is D," is disjunctive.

Now the two latter species of syllogisms may always be reduced to the former when occasion requires, and therefore an examination of the necessary laws of reasoning, together with the systematic arrangement induced by these laws, will best find place under the head of categorical syllogisms. Accordingly, in the following analysis, I shall speak simply of the

* Hamilton's "Logic," Lect. iii. p. 44.

arguments so denominated; this plan being consonant with that pursued when judgments were discussed.

§ 7. *The Fundamental Law of Mediate Inference.*

"Thought," says Sir W. Hamilton, "is the cognition of any mental object by another in which it is considered as included; in other words, thought is the knowledge of things under conceptions." This accords with what I have already stated concerning the grand principle of classification which underlies our faculties of acquiring knowledge; and prepares us to appreciate the fundamental law of mediate inference, which is as follows:—"*Whatever belongs or does not belong to the containing whole, belongs or does not belong to each and all of the contained parts.*"* This law, commonly called the "*dictum de omni et nullo*," we owe to the commanding genius of Aristotle, who first placed Logic upon a sound and durable basis. It is not, however, to be understood that this *dictum* is *directly* applicable to every case of reasoning; the assertion merely being that the validity of any argument is *ultimately* referable thereto.†

For practical purposes men seldom ascend to general and fundamental truths, but devise a system of rules which, being immediately applicable, may obviate much of the inconvenience and delay that would otherwise ensue. Hence it is that logicians have developed Aristotle's *dictum* into the following *proximate* canon. "If two notions agree either wholly or in part with one and the same third, they agree with each other; but if one of them is agreed and the other disagreed with the same third, they disagree with each other." This canon is, however, differentiated still further, thus:—

1. *A syllogism must contain three, and only three, terms, constituting three, and only three, propositions.* The force of this rule is at once evident when we consider that the object sought to be attained by syllogising, is to determine the agreement or disagreement of two notions by respectively comparing

* Hamilton's "Logic," Lect. xvii. p. 321.

† Some objections having been raised by Mr. Mill and others to this account of the fundamental law of mediate inference, I have discussed the question at greater length in article C of the Appendix.

them with a third. This, of course, could not be done if we employed more or less than the three terms, or formed more or less than the three judgments.

The names of these terms depend upon their position in the syllogism. The predicate of the conclusion is called the *major* term; the subject of the conclusion is called the *minor* term; while the third notion with which the two former are each compared is styled the *middle* term. In like manner are the premises named, that in which the major term is compared with the middle being the major premiss; the other, the minor premiss.

Much objection has been taken to this employment of the words major and minor on account of their ordinary signification being respectively "greater" and "smaller," whereas it sometimes happens that the minor term is in reality *greater* than the major term, or that we are unable to compare them together as regards their extent. There is no doubt that these names were originally imposed from their representing the facts of the case in one particular form of syllogism which was considered the most perfect; but as they have continued to be used by numerous logicians who were well aware of how the matter stood, it must be inferred that "major" and "minor," when used logically, have merely a technical meaning as distinguishing the terms of the conclusion, and not as implying any relative degree of amplitude. A parallel case is to be found in the use of the word "opposition" (see p. 41). In consequence of such objections, the premises of a syllogism have been variously re-named, the appellations of *proposition*, *lemma*, and *sumption*, being bestowed upon the major premiss, while the minor is known as the *assumption*, *subsumption*, or *hypolemma*.

2. *The premises must not both be negative.* This follows from the consideration that a term can only show the relation of agreement or disagreement subsisting between two others, in so far as it is applicable to one of them at least. If, for instance, we were first to say, "No mathematician is a good moral reasoner," and then that "Shakspeare was not a mathematician," these statements would give us no grounds of comparison between the notions of "Shakspeare" and "good

moral reasoner." We should still be uncertain as to whether the latter might or might not be predicated of the former.

3. *If either of the premises be negative, the conclusion must also be negative;* for this is precisely the case stated in the second portion of the proximate canon above laid down, viz., "If one notion is agreed and another disagreed with one and the same third, they disagree with each other." Thus, from the premises, "no matter is imponderable," and "all gases are matter," we can only conclude that "no gases are imponderable;" for the attribute of imponderability was totally denied of matter, which contains, *inter alia*, all gases.

4. *When the premises are affirmative, if either of them be attributive, the conclusion must also be attributive.* Since a substitutive premiss implies a *total* identicality in extent of the middle term with one of the terms of the conclusion, and an attributive premiss implies only a *partial* identicality of like nature, it follows that between the terms of the conclusion a *partial* identicality of extent is all that can be inferred. An example of this will be found in the following syllogism:—

Compounds are all bodies which may be resolved into simpler forms (U),
Sugar is a compound (A);
∴ Sugar is a body which may be resolved into a simpler form (A).

5. *The middle term must be more than distributed in the premises, both taken together.* For if this were not the case we should have no real inference whatever; as witness this apparent syllogism—

Some beautiful objects are pictures,
Some hideous objects are pictures;
∴ Some hideous objects are beautiful.

Here the two premises are in the form I, which we know does not distribute the predicate, this, in the present case, being the middle term "pictures." Accordingly, the major and minor terms may, for anything the form of expression can tell us, be compared with different portions of the same thing; and this, being equivalent to employing *two* middle terms, would violate the first rule, which prohibits the appearance of

more than three terms altogether. Of course it might so happen that when premises of the above nature were used, we arrived at a true conclusion, as in the following case :—

Some beautiful objects are pictures,
Some valuable objects are pictures ;
∴ Some valuable objects are beautiful.

This conclusion would, however, still be considered as invalid, that is, as not following directly and inevitably from the premises ; for Logic, it will be remembered, regards not the *matter*, but merely the *form* of reasoning.

Usually the middle term is distributed in one of the premises at least; we can then tell at a glance that the rule now under discussion is not violated. Take, for example, the syllogism—

All the metamorphic rocks have been subjected to the action of heat,
Gneiss is a metamorphic rock ;
∴ Gneiss has been subjected to the action of heat.

The major premiss being A, distributes the middle term ; and as this must be again mentioned in the minor premiss, it will necessarily be more than distributed, and will not affect the validity of the conclusion.

Sometimes, however, we meet with a syllogism whose premises contain the middle term in such a manner as to show that the portions employed in each, if added together, would give more than the whole ; *e.g.*—

Twenty per cent. of these knives are bad,
Ninety per cent. of them are apparently well-made ;
∴ Some of these apparently well-made knives are bad.

In this case suppose that the notion "bad" coincides with the entire portion of "these knives," with which "apparently well-made" does not ; such portion being only ten per cent. would still leave a further extent of ten per cent. to be accounted for, and this it is evident must come out of the "ninety per cent. ;" so that we are sure that the notions "apparently well-made," and "bad," must correspond to the extent of ten per cent. at least: this is asserted in the conclusion.

It will in this place be opportune to remark that much con-

fusion frequently results from the use of an *ambiguous* middle term, thus :—

Capes are articles of clothing,
Some tracts of land are capes ;
∴ Some tracts of land are articles of clothing.

This syllogism is *logically* correct, that is, in form ; but if we examine its matter, we shall see that it contains two middle terms, for in the major premiss one kind of "cape" is spoken of, while in the minor, another kind is alluded to. The discussion of such cases will be further conducted when we come to examine the subject of fallacies.

6. *In the conclusion no term must be distributed, unless it has also been distributed in one of the premises.* The terms of the conclusion only agreeing or disagreeing with each other in so far as they respectively agree or disagree with the middle term ; they can merely be compared with each other by means of those portions which were found to coincide in any way with the middle term.

All trees are organised beings (A),
Men are not trees (E) ;
∴ Men are not organised beings (E) ;

And again—

Diamonds are combustible (A),
Some precious stones are diamonds (I) ;
∴ All precious stones are combustible (A).

In the former of these syllogisms we have an *illicit process* of the major ; that is, the major term is distributed in the conclusion without being so in its premiss : in the latter there is, in like manner, an illicit process of the minor. The valid conclusions which might be inferred would respectively be "men are not *some* organised beings" (η), and "*some* precious stones are combustible" (I).

By the six foregoing rules may all syllogisms be tested to ascertain whether they are real or only apparent,—whether the reasoning is correct, or incorrect. They are of great practical importance, as they enable us to dispense with the reduction of many syllogisms into a form where the dictum of Aristotle might be *directly* applied ; but, as already stated, they must only be considered as proximate differentiations of one fundamental truth.

§ 8. *Of Figure.*

In order to facilitate a full examination of syllogistic arguments, that is, of arguments formally expressed, logicians have investigated the number of positions which the middle term may assume in the premises, and in accordance thereto, have formed four classes, under which all possible syllogisms may be ranged. These classes they call *figures*, the form of which may be represented as follows; employing P to signify the major term (predicate of conclusion), S the minor (subject of conclusion), and M the middle.

1st Fig.	2nd Fig.	3rd Fig.	4th Fig.
M P	P M	M P	P M
S M	S M	M S	M S
∴ S P	∴ S P	∴ S P	∴ S P

Thus when the middle term is the subject of the major premiss, and the predicate of the minor, we have the first figure; when it is the predicate of both, the second; when it is the subject of both, the third; and finally, when it is the predicate of the major, and subject of the minor, there results a syllogism of the fourth figure.

§ 9. *Remarks upon the four Figures.*

1. The first figure is the most natural and obvious form into which an act of reasoning can fall; the cause of this apparently being that it is the only one in which the Aristotelian dictum will at once and immediately apply. Thus, to give a concrete example—

The rushing of particles to a nucleus causes the body so formed to rotate,

The earth was formed in this manner;

∴ The earth rotates.

This argument, which is employed by the author of "Vestiges of Creation," I have expressed in popular language, but the student will find no difficulty in arranging it according to the model; "All M is P; S is M; therefore S is P."

2. The second figure, though a somewhat distorted method of stating an argument, is yet very useful and ready in certain

cases, where we desire to prove that some distinction exists between two notions, so as to prevent one of them including the other. Suppose, for instance, we wished to prove that a certain substance did not contain the metal sodium; we might employ such a syllogism as the following:—

Any substance containing sodium would give, when burnt, two yellow bands in its spectrum (U),
This substance when burnt does not do so;
∴ This substance does not contain sodium.

Here the middle term forms the predicate of both premises; consequently, the syllogism is of the second figure. If, however, we wished to apply the Aristotelian dictum, it would be necessary to arrange this argument according to the first figure, such an operation being termed *reduction*. It consists in a skilful application of the doctrines of opposition, conversion, and coincident junction. In the present case all that we have to do is to substitute for the major premiss its simple converse, thus—

Any substance which when burnt gives two yellow bands in its spectrum, contains sodium,
This substance when burnt does not do so;
∴ This substance does not contain sodium;—

a syllogism most manifestly of the first figure.

It has been held that in every case the mind unconsciously performs the process of reduction, and that therefore the second, third, and fourth figures are merely elliptical expressions of *trains* of reasoning, the first figure alone being an adequate representation of a *single* mediate inference. This statement, as implying a more *direct* influence than is usually imagined of the dictum upon our minds, is not unworthy of attention; but since a full examination of the question would occupy more space than could be conveniently devoted to the purpose, I shall remain satisfied with having shown that any argument may be overtly expressed in such a manner as to evince its dependence upon the great fundamental law of reasoning.

3. The third figure is of use when we wish to disprove a theory by instancing some example to the contrary. If we wished to combat the assertion that "no bodies except water

ever expand when cooling," we might do so in this manner :—

Bismuth sometimes expands when cooling,*
Bismuth is a body other than water ;
∴ Some other body than water occasionally expands when cooling.

The conclusion thus obtained is the contradictory (I) of the theory to be disproved (E), and accordingly our purpose is accomplished. In order to reduce this syllogism to the first figure, we must simply convert the minor premiss, when the whole will run thus—

Bismuth sometimes expands when cooling,
Some other body than water is bismuth ;
∴ Some other body than water occasionally expands when cooling.

4. The fourth figure is chiefly remarkable for the offence which it has given to many logicians, who accordingly have been neither sparing nor gentle in their attacks upon it : "tortuous," "unnatural," "perverse," "hybrid," "useless," "clumsy," "a monster," and "a caprice" may be taken as samples of the objections raised to its reception. It will, therefore, be advisable to examine the nature of some syllogism in this figure : take, for instance, De Quincey's† explanation of the non-existence of duelling among the ancient Greeks and Romans, which is as follows :—

No duelling can exist wherever unlimited license of tongue is allowed to anger (E),
Unlimited license of tongue was allowed to anger among the ancient Greeks and Romans (U) ;
∴ Among the ancient Greeks and Romans duelling could not exist (E).

Here it is objected that the mind naturally expects the converse of the conclusion, in accordance with the tendency of the argument—this leading from "no duelling can exist where certain license is allowed," to "this license was allowed among the Greeks and Romans," and then in all symmetry to "no duelling could exist among the Greeks and Romans."

Now the answer to this is, that the figure of a syllogism

* It invariably expands at the point of solidification.
† Works. Author's Edition. Vol. vii. p. 281.

depending entirely upon the position of the middle *term* in the *premises*, it will not be affected by a change in the relative positions of *conclusion* and premises. We have, therefore, only to state the conclusion first, and then give the premises as our reasons for forming it, when we shall at once obtain a smooth and naturally proceeding argument. Thus, we can say "Among the ancient Greeks and Romans duelling could not exist; for this is impossible where unlimited license of tongue is allowed to anger, which was the case in Greece and Rome;" than which a more harmonious expression could not easily be found.

In like manner, if we take mere arbitrary symbols to represent the three terms, we shall still have a perfectly clear syllogism, *e.g.*—

No S is P (conclusion);
for No P is M (major premiss),
and M is all S (minor premiss);

the meaning of which is, that none of the objects comprised by S are included by P, since the latter is totally excluded from M, which contains the same objects as S.

At the same time, however, that the fourth figure is thus shown to be perfectly legitimate and unforced, it may be readily conceded that it is but seldom used, as from the same premises and the converted conclusion we can form a syllogism of the first figure: thus, "M is all S; no P is M; therefore no P is S;" which being, as it were, more familiar to the mind, is oftener suggested.

The formal reduction of syllogisms like the above to the first figure, is effected by simply converting both premises; *e.g.*—

No M is P,
All S is M;
∴ No S is P.

§ 10. *Of Mood or Mode.*

The arrangement of the propositions of a syllogism with reference to their quantity, quality, and relation, is termed the *mood* or *mode* of the syllogism; and as we are in possession of symbols which fully express the form of a proposition, we can at all times represent the mood by the arrangement

of these letters : the conclusion, it is well to remark, being always placed last.

Now as there are eight kinds of propositions, viz. U, A, E, η, Y, I, O, and ω,—it follows that five hundred and twelve forms of syllogisms or moods may be made. Most of these, however, do not constitute valid arguments, and therefore we must reject them ; *e.g.* A O A has an *affirmative* conclusion, though one of its premises is *negative ;* E O O has *both* premises *negative ;* I I I has either the *middle undistributed* or else an *illicit process ;* and so on in numerous other cases. In like manner some moods are admissible in one figure, but not in another ; thus, A I I is valid in each of the first and third figures, but in the second and fourth the middle term would be *undistributed.*

§ 11. *Table of Valid Syllogisms in each Figure.*

From the foregoing considerations it will be evident that a table may be constructed which will show all the valid syllogisms falling under each figure ; and as such a table is of great practical use, I have drawn up the following :—

TABLE OF MODES.

Fig. I.		Fig. II.		Fig. III.		Fig. IV.	
Aff.	Neg.	Aff.	Neg.	Aff.	Neg.	Aff.	Neg.
A A A	E A E	A U Y	A E E	A A I	E A O	A A I	A E E
A I I	E I O	A Y Y	A O O	A I I	E I O	A U A	E A O
A U A	E U E	. . .	E A E	A U A	E U E	A U Y	E I O
A Y I	E Y O	. . .	E I O	A Y A	E Y E	. . .	E U E
			E U E	. . .	. . .	. . .	E Y E
			E Y O	. . .	. . .	. . .	E Y O
I U I	O U O	I U I	. . .	I A I	O A O	I A I	
I Y I	O Y O	I Y I	. . .	I U I	O U O	I U I	
U A A	U E E	U A A	U E E	U A Y	U E E	U A Y	U E E
U I I	U O O	U I I	U O O	U I I	. . .	U I I	U O O
U U U	. . .	U U U	. . .	U U U	. . .	U U U	
U Y Y	. . .	U Y Y	. . .	U Y A	. . .	U Y A	
						U Y Y	
Y U Y	Y E E	Y A A	. . .	Y A Y	Y E E	Y I I	
Y Y Y	Y O O	Y I I	. . .	Y U Y	. . .	Y U A	
		Y U A				Y Y I	
		Y Y I					

The above table is arranged alphabetically, so as to facilitate reference, and enables us at once to determine the validity or invalidity of any syllogism whose figure is known; for if legitimate, it will be found in its proper position, while if inadmissible, it will be absent.

The propositions η and ω have been omitted from this table on account of their small importance (see p. 34). It may also be proper to remind the student that in most of the older treatises on Logic he will find tables of judgments which differ materially from the one above given, inasmuch as they only recognise the four propositions A, E, I, and O. The usual form in which such a table is given consists of the following four mnemonic Latin verses:—

Fig. I. Barbara, Celarent, Darii, Ferioque, *prioris;*
Fig. II. Cesare, Camestres, Festino, Baroko, *secundæ;*
Fig. III. *Tertia,* Darapti, Disamis, Datisi, Felapton, Bokardo, Feriso habet: *quarta* insuper addit
Fig. IV. Bramantip, Camenes, Dimaris, Fesapo, Fresison.

These lines, or rather the first three, were the invention of Pope John XXII., whose work upon Logic, under his name of Petrus Hispanus, enjoyed great celebrity. To each of the four figures it will be observed that a verse is appropriated, consisting chiefly of a number of names distinguished by capital letters,* and containing three vowels; the vowels thus employed serve to indicate the mood of the respective syllogisms. For instance, the syllogism "all M is P; all S is M; therefore all S is P," is said to be in the mood *barbara*, which signifies A A A in Fig. I. The *consonants* of the various moods are intended to assist the process of reduction; the *initial letters* show that each mood must be reduced to that mood in the first figure which is similarly characterised: *s* indicates that the proposition immediately preceding is to be *simply* converted (in its old acceptation; see p. 46); *p* that it is to be converted *per accidens*, except in the mood *bramantip*, where it denotes that the conclusion (I) will, when the syllogism is reduced, become A; *m* that the premises are to be transposed; and *k* that the contradictory of the con-

* Tertia, in the third verse, is merely employed for the sense of the expression, and is not a mood.

clusion is to be substituted for the immediately preceding proposition. The two moods, however, in which *k* occurs (*baroko* and *bokardo*) may be more simply reduced by employing the process of privative conversion; they will then become *ferio* and *darii* respectively.

An example will perhaps assist in rendering the above description intelligible. Let us take a syllogism in *disamis;* thus,—

Some rocks have been formed by the action of water (I),
All rocks are solid (A);
∴ Some solid things have been formed by the action of water (I).

Here the *m* indicates that the premises must be transposed, the major and conclusion being simply converted in accordance with the requirements of *s* and *s*. When this is done, we obtain the following :—

All rocks are solid (A),
Some things which have been formed by the action of water are rocks (I);
∴ Some things which have been formed by the action of water are solid (I);—

which is a syllogism in *darii*, that mood of the first figure which was indicated by *D*, the initial letter of *disamis*.

I have thought it advisable to enter at some little length upon this subject, as these ancient names of moods are not confined to logical works, but are often to be met with in old authors; in addition to which, it might be expected that in a work like the present, of professedly a practical character, some notice would be taken of a method so universally followed. In fact, the perfect adaptation of the above quoted lines to their purpose, would alone render them deserving of mention; for, as Sir William Hamilton observes, "it must be confessed that, taking these verses on their own ground, there are few human inventions which display a higher ingenuity."

It must also be observed that so far from the method just described being out of date and obsolete, it may still be applied in many cases; the only difference between it and the table of judgments given in the present volume, being

that the latter is much more complete, containing not only all that the A, E, I and O system includes, but many other syllogisms in addition.

§ 12. *Induction and Deduction.*

We have now seen that all acts of mediate inference when formally expressed, *i.e.* all syllogisms, may be systematically arranged and discussed under the two heads of mood and figure. There are, however, some further divisions of syllogisms which require our attention; the first of these being that into *inductive* and *deductive*.

The distinction between these two methods of reasoning may be thus expressed: induction is the process of forming a general law; deduction, that of applying a law so made to some particular case or cases. Or, in other words, induction consists in reasoning from the *parts to the whole;* deduction, in reasoning from the *whole to the parts.* In *formal* Logic, however, this distinction is comparatively unimportant, as will be seen from the following considerations.

Take some inductive syllogism, as follows:—

Oxygen, chlorine, and steam are elastic (A),
Oxygen, chlorine, and steam are all gases (U);
∴ All gases are elastic (A).

Here we see that from predicating "elastic" of the various parts "oxygen, chlorine, and steam," we are enabled to predicate it also of the whole thus constituted, viz., "gases." It is, therefore, evident that the general law or truth upon which the validity of such a syllogism depends, may be thus expressed:—"That which belongs, or does not belong, to each and every one of the parts, also belongs, or does not belong, to the whole." This law has been declared to differ from the *dictum de omni et nullo,* which, the student will remember, is to the following effect: "That which belongs, or does not belong, to the whole, also belongs, or does not belong, to each and every one of the parts." Now if we admit the difference thus asserted—that is to say, if we admit that these two laws are "equally necessary and *independent*"*—then we must, in

* Hamilton's "Logic," vol. i. p. 321. The italics are my own.

addition, admit that the division into inductive and deductive syllogisms is imperatively called for, since each species of reasoning will have been shown to rest upon separate fundamental * laws.

That this independence, however, does not exist, may be shown by a few reflections based upon the nature of what we understand by the notion of a "whole." In the case under examination the "whole" of which we speak is the conception "gas." This, as the student will recollect from what was said in a previous chapter, is the result of our comparing various bodies together, and ascertaining those attributes in which they are all agreed; the set of attributes so obtained being then abstracted to form the idea, and receive the name of "gas." Consequently, when we say "gases," we think of a class whose members are, *not various individual objects*, but *various similar sets of attributes* existing in separate bodies or objects, viz., "oxygen, chlorine, and steam;" and when we say that what may be predicated of the class "gases," may also be predicated of each of its members, we mean that the attribute "elasticity," for instance, may be predicated of oxygen, chlorine, and steam, not as *individual objects*, but as *separate and similar sets of attributes;* or, in other words, we imply that each set of attributes must be capable of forming the idea "gas" in our minds, and must, consequently, be of similar constitution with the remainder. In like manner, when we say that whatever may be predicated of each member may be predicated of the class "gases," we mean that whatever attribute is common to oxygen, chlorine, and steam must form part of that *set of attributes* which is called "gas;" that is, we imply that oxygen, chlorine, and steam, *considered as definite sets of attributes*, are of similar constitution, and must consequently each be capable of forming the same idea, "gas," in our minds. Now these two expressions, which are thus seen to have almost identical meanings, are the self-same laws which have been spoken of as independent of each other; this statement, therefore, is seen to be incorrect, and, accord-

* As regards the use of the word *fundamental* in this place, see Appendix C.

ingly, we need not consider the distinction between the processes of induction and deduction as more than a logical trifle.

It must here be rigidly borne in mind, that the above remarks only apply to induction and deduction when considered as divisions of *pure* Logic ; for when we come to treat upon *applied* Logic, it will be found that another kind of induction exists, which necessitates a particular mention, and which is of very great importance. The difference between these two kinds of induction is closely connected with a fact which the student has doubtless observed, viz., that the minor premiss of our inductive syllogism is obviously incorrect, for so far from oxygen, chlorine, and steam being *all* gases, they only constitute an exceedingly small portion of the class. This brings us to the consideration that in formal Logic we have nothing at all to do with *truth* or *falsehood ;* we can only ascertain whether a conclusion *legitimately* follows from premises already *granted.* Accordingly, we merely look upon the minor premiss with reference to its *form, i.e.,* its quantity, quality, and relation, and not as regarding its *matter*, viz., the *reality* and *nature* of the notions composing the subject and predicate : thus, for all purely *logical* purposes, the proposition might be replaced by "X, Y, and Z, are all S" without in the least interfering with the reasoning process. Applied Logic, on the contrary, takes into account the relative natures of the objects furnishing notions, and would construct the syllogism in the following manner :—

Oxygen, chlorine, and steam are elastic (A),
Oxygen, chlorine, and steam are gases (A);
∴ *All* gases are elastic (A).

Here it will be seen that the minor premiss is indeed *true,* but then there is an *illicit process* of the minor term, so that the syllogism cannot be admitted as *formally* valid.

The deductive syllogism corresponding to our inductive example would be as follows :—

All gases are elastic,
Oxygen is a gas ;
∴ Oxygen is elastic—

where the general law is applied to a particular case.

§ 13. *Extension and Intension.*

In a former chapter it was explained that a proposition might have its meaning regarded from different points of view, according as the subject and predicate were regarded intensively or extensively. Thus, when we say, "All fluids are compressible," we mean not only that the attributes of "compressibility" are among the attributes of every "fluid" (intension), but, also, that the class of "compressible substances" numbers in its ranks all "fluids" (extension). This differentiation of meaning, in like manner, finds place among arguments, and thence has arisen a distinction of syllogisms into *extensive* and *comprehensive* (intensive). An extensive syllogism is of this nature—

Motion is immaterial,
Heat is motion;
∴ Heat is immaterial,—

and would be thus interpreted:—

Motions are contained in the class of immaterial objects,
Heat is contained in the class of motions;
∴ Heat is contained in the class of immaterial objects.

The same syllogism, if stated comprehensively, or intensively, would run as follows:—

Heat is motion,
Motion is immaterial;
∴ Heat is immaterial;—

and its meaning, when broadly stated, would be this:—

Heat comprehends in it the attributes of motion,
Motion comprehends among its attributes those of immateriality;
∴ Heat comprehends the attributes of immateriality.

An examination of these four syllogisms will reveal their dependence upon each other; all of them being evidently the same result of the same process of reasoning. This is rendered clear by a brief analysis of the import which attaches to predication. We say, for instance, that "motion is immaterial," and in doing so we state that a certain relation of congruity exists between two compound ideas: "*motion*," which consists of two sets of attributes, viz., the generic feature "immateriality" and certain specific differences; and "*immaterial*

objects," which likewise is duplicate, containing the notion "immateriality" *per se*, and the notion of "immateriality" indefinitely repeated, as existing in combination with various sets of specific differences. It therefore results that the *relation* implied by our predication is also *compounded*, its constituents being, that motion is an immateriality united with certain distinguishing marks; and that motion is capable of producing on the mind, together with other impressions, the same idea that immateriality *per se* would do. These two relations it will easily be seen are those of extension and intension. But another fact remains to be noticed: that although the two ideas and relations are thus shown to be *compound*, yet the union of their respective parts is so intimate that they cannot be separated. We are unable to resolve the idea "motion" into its two sets of attributes, "immateriality" and "specific differences," so as to think of these separately, and at different times: we are also unable to divide the idea "immaterial objects" into "immateriality" *per se*, and "immaterialities" respectively combined with distinguishing attributes; and, finally, we are unable to think of one of the relations above described without also thinking of the other. The utmost we can do is to bring one portion of the compound idea, or relation, into greater prominence than its fellow, by concentrating our attention *as much as possible* upon the chosen part; it being remembered that we cannot so concentrate the *whole* of our attention, and, therefore, we must always, in some measure, be impressed by the less important constituent.

These observations, if taken in conjunction with those contained in the section upon induction and deduction, will, it is hoped, afford an intelligible and clear view of the manner in which the mind acts when comparing notions and judgments; and as the operation is always identical, being, though complex, yet irresoluble, it follows that the only useful, or, strictly speaking, admissible division of judgments and reasonings, is that which merely refers to their form. Hence, in formal Logic the distinction between the processes of extension and comprehension must, like that between induction and deduction, be considered as of trifling consequence.

§ 14. *Denomination.*

When speaking of the interpretation of the copula, I mentioned that another mode of doing so had been suggested, in addition to those connected with the doctrines of extension and intension. This was the interpretation of *denomination*, and is as applicable to arguments as to propositions: for example, the syllogism—

All planets are stars,
Mercury is a planet;
∴ Mercury is a star,

may be thus translated:—

Planets may be called stars,
Mercury is a planet;
∴ Mercury may be called a star.

This interpretation is, of course, merely verbally significant, and is not intended to imply any approach to a radical, or even formal difference between the syllogisms. The doctrine, if doctrine it may be called, must, therefore, be received as nothing more than a practical hint for turning a syllogism to some special account, and as such belongs properly to applied Logic. Former usage, however, is my excuse for placing it here.

§ 15. *Syllogistic Arrangement of Propositions.*

Before concluding the subject of pure-categorical syllogisms, it will be advisable to mention a matter about which the student might otherwise entertain an erroneous opinion. I allude to the *order* of the three propositions constituting a syllogism. It will have been observed that the usual course pursued is to place the major premiss first, the minor next, and the conclusion last; and it may consequently be thought that this order is the one most in accordance with natural laws. Such, however, is not the case; the arrangement in question being merely an arbitrary practice adopted by logicians in order to facilitate their expositions of the science.

In fact, it frequently happens that the conclusion occurs to the mind as a problem or thesis, which requires certain judgments (premises) to be formed, in order that its validity

may be apparent. Thus, I might suspect a certain gas to be hydrochloric acid, but in order to be sure it would be necessary for me to find some *proof* of this. Accordingly, knowing the general law that ammonia produces white fumes only when brought into contact with hydrochloric acid, I should proceed to test the suspected gas in this manner; and, the anticipated result following, I should be enabled to construct the syllogism :—

This gas is hydrochloric acid;
Because, It produces white fumes with ammonia,
And, Everything which does that must be hydrochloric acid.

Here the premises and conclusion are reversed. Again, some fact comes under our notice, such as, "This metal takes fire upon touching water;" we make inquiries, and find that "The only metal behaving in such a manner is potassium;" hence we draw the conclusion that "This metal is potassium." An argument so expressed is a syllogism of the first figure, but with the premises reversed. Accordingly, it thus appears that there is no natural and definite *order* of judgments; it cannot, therefore, be said that any arrangement is incorrect, or alone correct, the disputes between logicians upholding different models being so many lost words, we can scarcely say arguments.

§ 16. *Conditional Syllogisms.*

We have now to consider the case of syllogisms whose constituent propositions are not all pure-categoricals; and first we will examine those in which one or more *conditional** judgments appear, the argument being then termed a conditional syllogism.

Now these reasonings may be treated in two ways—practically, and theoretically; that is to say, their own special canons or proximate rules may be applied to them as they stand; or they may be reduced to categorical syllogisms, when, of course, they immediately fall under the laws which

* I omit *modal* propositions, as these cannot be treated otherwise than as pure-categoricals. See p. 28.

have been analysed in the foregoing pages. And, first, as they stand.

Every conditional proposition consists of two parts—the antecedent and the consequent—between which a certain relation is asserted to exist. These parts are both distinct judgments, the relation being that the consequent depends upon the antecedent in such a manner as to necessitate the inference of the former if the latter be granted; *e.g.*, "If the anchor holds out, the ship will be saved," where "If the anchor holds out" is the antecedent, "the ship will be saved" is the consequent, and the relation asserted is, that if we admit that the anchor *will* hold out, then we must also admit that the ship will be saved. A complete syllogism having such a proposition for a premiss, would be of the following form:—

If the anchor will hold out, the ship will be saved,
The anchor will hold out;
∴ The ship will be saved.

In cases where *both* the premises are conditional, then the conclusion must be conditional also, *e.g.*—

If the anchor will hold out, the ship will be saved,
If the storm does not increase, the anchor will hold out;
∴ If the storm does not increase, the ship will be saved.

Now, from a consideration of the relation subsisting between the antecedent and consequent of a conditional proposition, logicians have devised two practical rules, which suffice to determine the validity of any conditional syllogism without reducing it to a categorical form. These are:—

1°. *If the antecedent be granted, the consequent may be inferred;* for this is merely to state the nature of the assertion made by the form of the proposition. Nothing, however, follows from granting the consequent: thus, in the proposition "If he is truly wise, he will be happy," we must infer that he will be happy, if we admit that he is truly wise; but admitting him to be happy will not prove him to be wise, as it is possible for an ignorant person to enjoy himself.

2°. *If the consequent be denied, the antecedent may also be denied.* This follows from the consideration that the truth of the consequent is necessitated by that of the antecedent, so that if the latter were true, the former would be so too.

If, for example, we deny the consequent of this proposition, "If he be shot through the heart, he is dead," and say that he is not dead, we may evidently infer that he is not shot through the heart; but to deny the antecedent would not enable us to say that he is not dead, because he may have been killed by many other causes.

These two laws have given occasion to a division of conditional syllogisms into two moods, viz., the *ponent*, wherein the antecedent is granted, and the *tollent*, where the consequent is denied. These moods are reciprocally convertible, as may be seen from the following example: —

If the moon is not shining, the night is dark,
The moon is not shining;
∴ The night is dark.

This is in the ponent mood; but if we wish to make it tollent, we may do so by reversing the hypothetical, and duly negating, thus: —

If the night is not dark, the moon is shining,
The moon is not shining;
∴ The night is dark.

These moods are also termed constructive and destructive, answering respectively to ponent and tollent.

The second method of treating conditional-syllogisms is, by reducing them to categoricals. Such a proceeding has, indeed, been condemned by high authority* on the ground of its being unnecessary and not always possible. I venture, however, in common with many logicians,† to think that this condemnation is erroneous, as both of the objections urged may be thus disposed of. The reduction is *necessary*, as, by this means, conditional-reasoning being brought under the same *proximate* laws with categorical arguments, is shown to be of exactly the same nature, and so the unity of the reasoning process is maintained; at the same time, however, I do not contend that it is necessary for *practical* purposes, as then the rules above explained would become inept. Again, that the

* Krug's "Logik," p. 258. Bachmann's "Logik," § 89, Anm. 2. Sir W. Hamilton's "Logic," vol. i. p. 342.

† Esser's "Logik," § 99; Wolf's "Philos. Rat.," § 412; Whately's "Elements," book ii. chap. iv., § 6; Thomson's "Outlines," § 73.

reduction is *never impossible*, may be seen from the very case adduced as presenting insuperable difficulties, viz., "If A is C, B is D; but A is C; therefore, B is D;" where we have only to say, "*The case of A being C* is *a case of B being D; the present case* is *a case of A being C;* therefore, *the present case* is *a case of B being D*," and the obstacle is surmounted, the resulting syllogism being a categorical in A A A, Fig. I., or, as the old logicians would say, in *Barbara*. The respective *terms* are here distinguished by being printed in italics.

That these objections should have been brought against the reducing process as applied to conditional syllogisms, is apparently owing, first, to the acceptance of the principle, "Infer nothing without a ground or reason" as a necessary and primary law of thought; and, secondly, to its being lost sight of that a term may be composed of more than one conception. With regard to the first of these causes, it may be observed, that the law there mentioned, called the law of reason and consequent, has been a subject of much discussion among metaphysicians and logicians, but should properly be referred to the former alone. By it the antecedent is explained as being "the complement of all, without which something else would not be," and the consequent as being "the complement of all that is determined to be by the existence of something else." This, which is Sir William Hamilton's explication, given with especial reference to conditional propositions, is, however, too wide and general for application in such cases; since, were we to admit that the consequent "*could* not be" without the antecedent, we must also admit, that by denying the antecedent we may deny the consequent, which is contrary to the second rule above given. It is likewise too wide and general to be considered as a separate law, for if the antecedent be the "*complement of all, without which* something else would not be," it must necessarily be that "something else" itself. Now, a thing cannot be something else; and, therefore, in order to attach any admissible meaning to the definition under question, we must interpret it thus:—"The antecedent is the same thing as the consequent, but from a different point of view," a state-

ment much the same as "a thing is itself," and answering to another primary law, viz., "whatever is, is." * Indeed, Sir William Hamilton's latest views would appear to have been in accordance with those advocated here, as we find him saying, that the law of reason and consequent "should be excluded from logic." †

The second source of objection which led to the statement that some conditionals could not be reduced, probably arose, as stated above, from an incomplete view of the structure of terms. Thus, in the syllogism, "If A is B, C is D; but A is B; therefore, C is D;" it was hastily concluded that there are four terms, A, B, C, and D; but, in so doing, it is assumed that the reasoning process concerns these simple notions; whereas, in fact, it is occupied with the more complex ideas, "A is B" and "C is D." Accordingly, instead of *four* terms, which of course would be incompatible with a categorical syllogism, we have only *two*, and require a third, viz., "the present case," before we can draw a conclusion. This third term is implied in the second premiss, when we say "A *is* B."

During the course of the preceding remarks, the student will doubtless have observed the technical method of reduction employed in these cases. It may be articulately enounced as follows: "Each conditional proposition is to be considered as a universal-affirmative-attributive categorical, with the antecedent for a subject, and the consequent for a predicate." Thus, the syllogism here stated,—

If a body is struck, heat is generated,
But if a meteorite falls into the sun, a body is struck;
∴ If a meteorite falls into the sun, heat is generated,

may be reduced in the following manner:—

All cases of "a body is struck," are cases of "heat is generated" (A),
All cases of "a meteorite falls into the sun," are cases of "a body is struck" (A);
∴ All cases of "a meteorite falls into the sun," are cases of "heat is generated."

* As regards the primary laws of thought, see Appendix C.
† "Discussions," p. 603.

In this way, or by using equivalent expressions, any conditional syllogism may be thrown into the form best adapted for displaying its real import as an act of reasoning.

§ 17. *Disjunctive Syllogisms.*

A *disjunctive* syllogism is an argument in which there is one, or more than one, disjunctive proposition, and may be represented by these formulæ: 1°. "A is either C or D; B is neither C nor D; therefore, B is not A." 2°. "A must be either C or D; but it is not C; therefore, it is D." 3°. "A is either C, D, or E; but it is not C; therefore, A is either D or E." 4°. "Either A is B, or C is D; but A is not B; therefore, C is D," &c. &c.

The import of the disjunctive propositions in all these syllogisms is, that the cases enumerated are the only possible ones, and that they are mutually exclusive; a perfect logical division has in fact been performed. Accordingly, the practical rules which result are—

1°. *From the assertion of one alternative, we may deny all the others; e.g.*, if in the proposition, "All men must be either white, black, red, or yellow," we were to affirm, "These men are red," we might infer that "they are neither white, black, nor yellow."

2°. *From the disjunctive assertion of more alternatives than one, we may deny the rest.* Thus, in the above example, if we were to say, for our second premiss, that "these men are either white or black," we should then conclude that "they are neither red nor yellow."

3°. *From the denial of one, or more than one alternative, we may assert such as remain; directly, if one, disjunctively, if more.* Accordingly, the following syllogism would be valid:—

All poems are either epic, lyrical, or didactic,
The poem of Paradise Lost is neither lyrical nor dadactic;
∴ Paradise Lost is an epic.

The reduction of disjunctive syllogisms to categoricals is similar to that of conditionals. Take, for instance, the syllogism just quoted—it will become:—

Poems which are neither lyrical nor didactic, are epics,
Paradise Lost is a poem which is neither lyrical nor didactic;
∴ Paradise Lost is an epic.

And here it must be stated, that in order to have a true conditional or disjunctive syllogism, it is necessary that the *reasoning* should hinge upon the *consequence* in the one case, and on the *alternative* in the other; for it is possible for a conditional or disjunctive *proposition* to exist in a categorical *syllogism;* thus,

All simple forms of matter are indestructible as such,
If the caloric theory be correct, heat is a simple form of matter;
∴ If the caloric theory be correct, heat is indestructible as such.

In this case, "*If the caloric theory be correct, heat*" must be considered as the minor term, for it is evident that the reasoning is merely a comparison of this, and the major term "indestructible as such," with the middle "simple forms of matter;" leaving the *consequence* of the conditional proposition altogether untouched.

§ 18. *The Dilemma.*

If in a syllogism there be a conditional premiss, whose antecedent or consequent is composed of a disjunctive proposition, such an argument is termed a dilemma, or hypothetico-disjunctive syllogism. Take, for example, the following:—

If the army were defeated, it must either have surrendered or retreated,
But it did neither of these;
∴ It was not defeated.

The rules upon which the validity of such syllogisms depend, are compounded of those referring to both conditionals and disjunctives; thus, 1°. *The antecedent being affirmed, either disjunctively or not, as the case may be, the consequent is also admitted;* and 2°. *The consequent being denied, either disjunctively or not, as the case may be, the antecedent is also denied.*

An argument of the above description is termed a *dilemma*

in consequence of its having two disjunctive members in the consequent of the major premiss: that is to say, it contains a double lemma, or double supposition. If there are three such members, it is a *trilemma*; if four, a *tetralemma*, and so on; but the name *polylemma* is usually applied to those containing more than four. Any one of these would, however, be loosely called a dilemma.

Such is the account commonly given of those arguments to which the name of dilemma is applied; but it is incomplete, as it does not refer to a class of syllogisms which, if anything, would fall more properly under that denomination. I allude to those in which several antecedents and consequents are disjunctively affirmed or denied; *e.g.*—

If he leaps out of the window, he will severely injure himself; if he does not do so, he will be burned,
But he must do either the one or the other;
∴ He must either severely injure himself, or be burned.

Or again—

If this man were happy, he would not be angry; and if he retained his self-command, he would not be excited,
But he is either angry or excited;
∴ He is either unhappy, or has lost his self-command.

In these syllogisms, we see that the major premiss (so to speak) is composed of two distinct conditional propositions, thus being a truer *di-lemma* than the cases previously considered.

All hypothetico-disjunctive arguments may be reduced, either to conditionals or categoricals at pleasure. There is no difficulty in the process, it being merely a judicious combination of the methods already studied, and as a general model, the following formula will be all that is needed. It shows the categorical reduction of a complex-dilemma, that is, where the major premiss is composed of two distinct conditionals.

Syllogism:—

If A is, B is; and if C is, D is,
But either A is, or C is;
∴ Either B is, or D is.

Reduction :—

1°. Take for a major *premiss* the categorical equivalent of the given minor; and for a minor *term*, the denial of the consequent in the *first* conditional of the given major premiss: complete the syllogism, thus

All non-A's are C's,
All non-B's are non-A's;
∴ All non-B's are C's.

2°. Take for a major premiss, the categorical equivalent of the *second* conditional in the given major; and for a minor premiss, the conclusion of the syllogism last formed: the conclusion resulting from these premises, will be the categorical equivalent of the disjunctive conclusion in the syllogism given for conversion: *e.g* —

All C's are D's,
All non-B's are C's;
∴ All non-B's are D's;
or
Either B is, or D is.

§ 19. *Incomplete Syllogisms.*

When any one of the propositions forming a syllogism is not overtly enounced, such an argument is termed an *Enthymeme.* It will be evident that there is no difference in the *reasoning process* between enthymemes and formal syllogisms, as the premises and conclusion are in both cases the same: the distinction merely consists in the number of judgments that may be actually expressed in words. Accordingly, since there are three propositions in every syllogism, enthymemes are divided into three orders, which respectively suppress the major premiss, the minor premiss, and the conclusion. Examples of them may be thus given :—

The formal syllogism :—

All women are inquisitive,
Julia is a woman;
∴ Julia is inqusitive.

Enthymeme of the first order (the major suppressed) :—

Julia is a woman;
∴ Julia is inquisitive.

Enthymeme of the second order (the minor suppressed) :—

All women are inquisitive ;

∴ Julia is inquisitive.

Enthymeme of the third order (the conclusion suppressed):—

All women are inquisitive,

And Julia is a woman.

Into one or other of these three forms, nearly all arguments, as popularly expressed, fall; for it is seldom that a person takes the trouble to state a syllogism in full. This elliptical method of overt inference, is most strikingly developed in those arguments which were discussed under the heads of *Opposition*, *Conversion*, and *Coincident-Junction*, where not only is a premiss not expressed, but it is almost *unconsciously* thought; so much so, indeed, that it requires a searching investigation to become convinced of its existence. We need not wonder, therefore, at their being often termed immediate inferences. Conditional judgments too, are frequently of an enthymematic nature, such as, for instance, "If Pegasus be a horse, it must be a quadruped," which manifestly proceeds upon the assumption that "all horses are quadrupeds."

§ 20. *Complex Arguments, or Chains of Reasoning.*

It often happens that we arrive at a conclusion through a string of correlative syllogisms, and when this is the case we have what is termed a *chain of reasoning*. These arguments are, however, generally of an enthymematic form, and are divided according as they suppress the conclusion, or one of the premises, in each syllogism.

Those chains of reasoning, where all conclusions but the one desired are suppressed, must necessarily consist of premises, and this form is known as a *sorites*. It may be of two kinds—first, where the predicate of each premiss is the subject of the next succeeding one, and where the conclusion is the last predicate affirmed of the first subject; this is termed the ascending, regressive, or Aristotelian sorites: and secondly, where the subject of each premiss is the predicate of the next, and where the conclusion is the first predicate affirmed of

the last subject; this is styled the descending, progressive, or Goclenian sorites. The formulæ of these are :—

Aristotelian.	Goclenian.
A is B,	D is E,
B is C,	C is D,
C is D,	B is C,
D is E;	A is B;
∴ A is E.	∴ A is E.

Or, concrete examples may be given, as follows :—

Aristotelian :—

Red is a colour,
A colour is a kind of light,
All light is a kind of motion;
∴ Red is a kind of motion.

Goclenian :—

All light is a kind of motion,
A colour is a kind of light,
Red is a colour;
∴ Red is a kind of motion.

It will have been observed, that the formulæ are entirely affirmative; this arises from the rule that we can draw no conclusion from negative premises. We may, however, have the last premiss of the series negative, but then the conclusion must be negative also, thus :—

Red is a colour,
A colour is a kind of light,
All light is a kind of motion,
No motion is material;
∴ Red is not material.

A sorites containing premises of the above description, may have its validity directly tested by this modification of the *dictum* :—"Whatever belongs, or does not belong, to a given whole, belongs, or does not belong, to each and every one of the parts constituting any whole contained in the given whole." If, however, the premises are of different forms (I, U, &c.), and the reasoning, in consequence, rather complicated, we may readily ascertain the legitimacy of the sorites by a process of dissection; that is, by resolving it

into its constituent syllogisms. The formulæ for this purpose are the following :—

Aristotelian.	Goclenian.
A is B, Minor,	D is E, Major,
B is C; Major,	C is D; Minor,
Minor, (∴ A is C), Conclusion.	Major, (∴ C is E), Conclusion.
Major, C is D;	Minor, B is C;
Conclusion. (∴ A is D), Minor,	Conclusion. (∴ B is E), Major,
D is E; Major,	A is B. Minor,
∴ A is E. Conclusion.	∴ A is E. Conclusion.

From this diagram, it will be seen that each suppressed conclusion forms the *minor* premiss of the succeeding syllogism in the Aristotelian sorites, and the *major* in the Goclenian. Accordingly, if we detect any false mood among the syllogisms, all its successors will be invalid, as depending upon an erroneous premiss.

A chain of reasoning, wherein one, or more than one premiss is suppressed, is termed an *epicheirema*, and may be of three orders ; first, where the *major* premiss of the main syllogism is the conclusion of another syllogism, with but one premiss expressed ; secondly, where the *minor* premiss is similarly characterised ; and lastly, where the conclusion forms the sole expressed premiss of a succeeding syllogism, a second conclusion thus resulting. The epicheirema may also be single, double, or treble, according as it is a combination of one, two, or three orders.

The nature of these arguments will be evident from an inspection of the following examples :—

Single epicheirema of the first order (the major a conclusion) :—

All planets are attracted by the sun ; for they revolve about him as a centre,
The earth is a planet ;
∴ The earth is attracted by the sun.

Single epicheirema of the second order (the minor a conclusion) :—

All birds are oviparous,
The condor is a bird ; for it has wings, feathers, and a heart ;
∴ The condor is oviparous.

Single epicheirema of the third order (the conclusion a premiss :—

Matter is imperishable,
Gold is matter;
∴ Gold is imperishable,
and
∴ Gold is eternal.

Treble epicheirema of the conjoint orders :—

He who is truly wise is just; for he is virtuous.
Aristides is truly wise; for he is led astray by no passions;
∴ Aristides is just,
and
∴ Aristides is happy within himself.

By symbolising, the last epicheirema may be thus extended into complete syllogisms; the propositions in parentheses being those which were suppressed :—

Conclusion.—A is B { (All C's are B's) major. / A is C . . . . minor.

Conclusion.—D is A { (All E's are A's) major. / D is E . . . . minor.

∴ D is B . . . . . minor.
(All B's are F's) major.
∴ D is F . . . . . conclusion.

The two syllogisms whose conclusions form the premises of the main argument, are called *prosyllogisms*, while the syllogism which takes the main conclusion for a premiss is termed an *episyllogism*.

In the strictest view of the science, pure Logic would take no cognisance whatever of incomplete or complex arguments; as in them the inference is not necessitated by the mere form of the expression. Since, however, all *practical* reasoning is of this nature, it would not be advisable to omit its consideration, as one of our objects is to show the universal extent of pure Logic, and also how its laws and principles pervade the whole universe of thought. We cannot, therefore, condemn the practice of logicians, who almost invariably have discussed these reasonings when treating upon the doctrines of logical elements.

§ 21. *Recapitulation.*

We have now concluded our investigation of the principles upon which the reasoning process is based, and of its various products. I shall, therefore, in accordance with my previous practice, briefly recapitulate the principal results at which we have arrived.

Reasoning in general is the eduction of a truth from some truths already established, but of whose full import we are not aware. It, therefore, cannot be an instrument for the *extension* of science, which would involve the discovery of fresh facts, but is of use in the due comprehension and orderly arrangement of our knowledge. It also follows that any processs of reasoning (termed a syllogism) is composed of two parts—the antecedent, or established truths, and the conclusion, or truth educed from them. Now the antecedent invariably consists of two judgments termed premises, but both of these are not always articulately enounced. This gives rise to a division of arguments into two classes; the one comprising certain syllogisms whose major premiss is always suppressed; the other comprising all that remain. The first of these classes is divided under three great heads, viz., *opposition*, or the relation subsisting between propositions which differ in form, but are identical in matter, such relation being either contradictory, contrary, subaltern, or subcontrary; *conversion*, or the transposition of the subject and predicate in a judgment, which may be of two kinds, simple and privative; and *coincident-junction*, or the inseparable union of the attributes in a conception. The second class, composed of formal syllogisms, requires as an essential preliminary of its treatment, the determination of a fundamental law which may decide the validity of all arguments. This law is found to be as follows: "Whatever belongs, or does not belong, to the containing whole, belongs, or does not belong, to each and all of the contained parts;" but, for proximate application, it is developed into this canon, "If two notions agree, either wholly or in part, with one and the same third, they agree with each other; but if one of them is agreed, and the other disagreed with the same third, they disagree with each other,"

which, variously differentiated for particular purposes, enables us to test the legitimacy of any syllogism. This canon formed, we find that all syllogisms whatever are susceptible of two methods of classification; first, with reference to the position of the middle term in the premises, whereby arguments are arranged into four *figures;* and, secondly, with reference to the form of the constituent propositions, the symbols representing these being grouped in threes, and termed *moods.* This distinction of figure and mood is sufficient as regards the form of syllogisms to determine their validity; but some other divisions respecting the import of arguments have a claim upon our notice. The doctrines of *induction* and *deduction* come first, and apparently depend upon different principles,—for induction reasons from the parts to the whole; deduction from the whole to the parts. A close examination, however, shows that, as far as *pure* Logic is concerned, they may be regarded as almost identical. Then follow *comprehension* (intension) and *extension,* which respectively interpret syllogisms as predicating an attribute of a notion, and a genus of a species; but this distinction also fades into obscurity when we reflect upon the irresoluble complexity of our ideas. Lastly, we have *denomination,* which identifies the reasoning process as one of naming; the significance of this interpretation being merely verbal. Having thus obtained a clear notion of the syllogistic theory, by confining our attention to arguments composed of categorical propositions, we proceed to the consideration of those cases wherein we meet with conditional judgments; and, by analysis, we find that they may all be referred to these two rules—1°. "The antecedent being granted, the consequent may be granted;" and 2°. "The consequent being denied, the antecedent may be denied." Next, taking the syllogisms which depend upon disjunctive judgments, we find that the principles involved are those of a perfect logical division; while those arguments which fall under the name of dilemma may be treated by a combination of the rules applicable to each of the two former classes. Lastly, we have to examine the popular method of stating arguments, and find that they either assume the form of *enthymemes,* or syllogisms with one proposition suppressed; or

else that they are expressed as *chains of reasoning*, these being of two kinds—a sorites, or string of premises with one conclusion ; and an epicheirema, or syllogism whose premises are the conclusions of prosyllogisms, and whose conclusion is the premiss of an episyllogism.

§ 22. *Conclusion.*

Here, as stated in the introduction, the province of *pure* Logic terminates ; and if the student has closely followed the foregoing analysis of its principles, he will be in a position to rightly appreciate its nature and end. Whatever may be the ulterior object for which the mind is cultivated, every person "must have thoughts to arrange, knowledge to transplant, and facts to record;" and the more effectually these can be done, the greater will be the progress. Now, the three great instruments for the above-mentioned processes are, first, Logic; secondly, languages ; and lastly, the arts of memory.* Thus the superiority and precedence of Logic in point of utility is apparent : it prepares a sure and solid foundation ; it arranges the materials as they arrive in regular courses ; and, finally, completes the majestic edifice of a well-ordered mind. Here, of course, I allude to the *science* of Logic ; that is to say, the knowledge of the formal laws of thought as applied to the treatment of *acquired* information ; consequently, we must not suppose that pure Logic will furnish us with powers of observation, or with facts to observe ; its sphere being limited to the invigoration of those mental abilities with which we are respectively endowed, and to the elucidation of those truths which have already attracted our attention. It is but the few whom Nature has endowed with great intellectual power ; and no amount of Logic, or of mental training, will supply the original deficiency. A Bacon or an Aristotle is born, not made. At the same time, however, the most commanding genius is capable of being raised to a still loftier

* Compare De Quincey, "Works," vol. xiii. p. 25, who advocates these views in a series of Letters, respecting which one can scarce tell whether most to admire their purity of style, their elegance of diction, their cogency of argument, or their subtle play of humour.

elevation; as much so as is the weakest mind. We are not, therefore, surprised to discover that the names of the most sedulous cultivators of Logic are those of the greatest philosophers that have ever lived. From Socrates, Plato, and Aristotle to Bacon; from Kanâda and Gotama to Kant; whether among the academic groves of ancient Athens, the busy haunts of British industry, the tropical luxuriance of eastern climes, or the ponderous reflections of learned Germany, there has ever been a bright succession of eminent men who have devoted their efforts to the investigation of the human mind, its thoughts, their principles, and laws. These principles they have employed, not only as regulators of the intellect, but also as guides and restraints in their search after truth, both moral and physical—such a disposition of the science being what is termed *applied* Logic, which will form our next subject of study.

CHAPTER V.

OF FALLACIES.

§ 1. *Applied Logic in General.*

We have now left behind us the sterile, but grand and impressive realms of theory, and are entered upon the luxuriant regions of practice, where there is everything to interest and to delight, but whose green and smiling soil too often hides a treacherous morass. Here, then, is the opportunity afforded to us of putting our experience to the test, and of determining in what way the rules, which we have been acquiring, may be of service to us.

Now, the ultimate end of all thinking, is the attainment of truth, and therefore, when we have ascertained what are the necessary laws of thought, we should not remain satisfied with this speculative knowledge, but should actively employ it as a means of advancement towards that higher object for which those laws were implanted. This operation it is, which forms the province of *applied* Logic, and which we are now about to consider, although the limits of our space must necessarily preclude any attempt to do more than take a cursory—but I trust, instructive—view of so vast a subject.

I have said that our object now is, to examine into the employment of the formal laws of thought as thought, for the purpose of attaining truth; and since we continually make use of one fact as a means of arriving at another, it follows that the practical application and operation of inference, must occupy much of our attention. Inference, however, may be examined from two points of view, positive and negative; for we must either reason correctly or in-

correctly: it follows, therefore, that the spheres of investigation which present themselves are—first, the essential conditions of, and inducements to, a legitimate inference; and secondly, the causes and nature of an illegitimate inference. The question now comes, which of these subjects shall we first examine? and the *ratio decidendi* must be the *end* which we propose to ourselves: this is the acquirement of truth, and can only be attained by a proper understanding of what constitutes correct inference. But, in order to properly understand what a thing is, we should first ascertain what it is *not;* for, as Bacon says, "Inductio quæ ad inventionem et demonstrationem Scientiarum et Artium erit *utilis*, Naturam separare debet, per *rejectiones et exclusiones debitas;* ac deinde *post negativas* tot quot sufficiunt, super affirmativas concludere." Accordingly, our immediate duty must be to investigate the conditions and concomitants of *incorrect* inference, or "bad reasoning," as it is generally termed.

Every argument consists in drawing a conclusion from certain evidence which has been adduced, and if this evidence be such as to warrant the conclusion, we are said to reason legitimately; if not, the reverse. Now, as no man ever assents to a judgment unless he deems its evidence conclusive, a case of false reasoning can only occur where the evidence, though seemingly just and sufficient, is, in reality, fallacious and deceptive; such an argument is called a *fallacy*.

§ 2. *Classification of Fallacies.*

The true way of comprehending any subject is—as we discovered when treating upon pure Logic—to arrange it in a system constructed upon the principles of logical division and classification. It, therefore, behoves us, if we would make a practical use of the science, to at once arrange the various fallacies under their respective heads, before proceeding to discuss them in detail.

Every syllogism consists of two parts, *form* and *matter:* this enables us to divide all fallacies into two great classes, viz., those whose inference is erroneous, through being informally

expressed ; and those where the premises legitimately imply the conclusion, if the *form* of the syllogism be alone regarded, but where an examination of the *matter* will show the reasoning to be invalid.

Formal fallacies are those which violate the syllogistic canons, and may be subdivided into as many co-ordinate species as there are proximate rules. It will only be necessary, however, for our purposes, to regard the faults of *undistributed middle* and *illicit process.*

Material fallacies may be erroneous, either as regards their terms, their premises, or their conclusion, and are consequently subdivided into these three subaltern genera, viz., *quaternio terminorum*, or syllogisms with four terms ; syllogisms with a *premiss unduly assumed ;* and *ignoratio elenchi*, or syllogisms which do not prove the required conclusion.

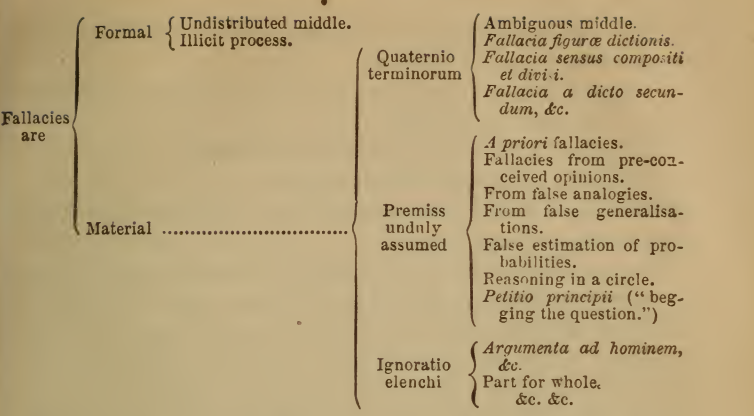
The species of these subaltern genera, may be arranged in accordance with the following considerations :—

1°. *Quaternio terminorum.* This fallacy may arise from the ambiguity of the middle term, so that in the major premiss one sense of the word is used, in the minor, another. Or, for any one of the terms, two words may be employed which are supposed to imply the same meaning, but do not. Or, again, a term may consist of several notions, these being taken together in one judgment, and separately in the other. Or, lastly, a term may be used absolutely in one judgment, and relatively in the other.

2°. *A premiss unduly assumed.* The causes of this may be,—considering certain truths as self-evident which are not so ; forming a judgment from some pre-conceived opinion, false analogy, or false generalisation ; over-estimating the weight of probabilities ; reasoning in a circle; or, taking for a premiss some proposition which is the same as, or implies, the conclusion.

3°. *Ignoratio elenchi.* This occurs whenever appeals are made to the passions, prejudices &c., of men ; when a part is proved instead of the whole ; &c., &c.

The foregoing division may be exhibited in a "scheme," as follows :—



Before we commence the discussion of each of the above fallacies in its order, it may be well to remark that the above division could only be logically perfect, provided we were allowed to make arbitrary distinctions between individual examples of false reasoning; for there are some fallacies which belong to one species equally as much as they do to another. This, in many cases, arises from the enthymematic mode of expression which obtains so universally: were a man, for example, in maintaining the efficacy of imprisonments for life, to argue that "capital punishment is improper," because "it does not tend to make the criminal a better member of society," we must either suppose him to hold that "*all* proper punishments are for the purpose of reformation, as regards the criminal's social behaviour," or that *some* are. In the former case, the complete syllogism would run thus :—

All proper punishments are intended for the criminal's social reformation,

Capital punishment is not so intended;

∴ Capital punishment is improper.

Here the formal reasoning is perfectly valid, but when the *matter* is examined, we see that the major premiss is unduly assumed; for, obviously, imprisonment for *life* is not intended to make the criminal a better member of society, as it starts with the condition that he shall never mix with his fellow-creatures again.

If we adopt the latter of the suppositions stated above, the argument will be as follows :—

Some proper punishments are intended for the criminal's social reformation,

Capital punishment is not so intended ;

∴ Capital punishment is improper ;—

where there is an illicit process of the major term, and, consequently, a formal fallacy.

In cases similar to the foregoing, it must always remain doubtful as to which class they belong ; and, therefore, the division adopted must be considered as only approximatively correct. This state of things, however, obtains in every science, and arises from the necessary imperfection of our knowledge : in chemistry, for instance, it is a moot point as to whether arsenic should be included amongst the metallic or non-metallic elements ; while, in biology, it is almost impossible to draw the line between animal and vegetable life. At the same time, most classifications are correct enough for all practical purposes, if not in strict accordance with the rigorous requirements of theoretical truth. Thus much premised, we shall now enter upon a detailed account of the various species of fallacies.

§ 3. *Formal Fallacies.*

These, as already stated, consist of such syllogisms as violate the canons which have been laid down for the purpose of determining the validity of an argument from its form. The principal species are Undistributed middle, and Illicit process. Examples may be thus given :—

Undistributed middle :—

Negroes are men,
Hindoos are men ;
∴ Hindoos are negroes.

Illicit process :—

All planets revolve round the sun,
All planets are stars ;
∴ All stars revolve round the sun.

The subject of form has been so fully discussed in the preceding chapter, that it will not be necessary to add anything

further upon this point. The following observations, however, taken from Archbishop Whately's "Elements," are of great importance.

"To the present class [formal fallacies] we may the most conveniently refer those fallacies, so common in practice, of supposing the conclusion false because the premiss is false, or because the argument is unsound; and of inferring the truth of the premiss from that of the conclusion. *e.g.*, if any one argues for the existence of a God, from its being universally believed, a man might, perhaps, be able to refute the argument by producing an instance of some nation destitute of such belief; the argument *ought* then to *go for nothing:* but many would go further, and think that this refutation had *disproved* the existence of a God; in which they would be guilty of an illicit process of the major term: viz., 'Whatever is universally believed must be true; the existence of a God is not universally believed; therefore, it is not true.' Others again, from being convinced of the truth of the conclusion, would infer that of the premises, which would amount to the fallacy of an undistributed middle: viz., 'What is universally believed is true; the existence of a God is true; therefore, it is universally believed.' Or, these fallacies might be stated in the hypothetical form; since the one evidently proceeds from the denial of the antecedent, to the denial of the consequent; and the other, from the establishing of the consequent, to the inferring of the antecedent; which two fallacies will usually be found to correspond respectively with those of Illicit process of the major, and Undistributed Middle.

"Fallacies of this class are very much kept out of sight, being seldom perceived even by those who employ them; but of their practical importance there can be no doubt, since it is notorious that a weak argument is always, in practice, *detrimental*; and that there is no absurdity so gross which men will not readily admit, if it appears to lead to a conclusion of which they are already convinced. Even a candid and sensible writer is not unlikely to be, by this means, misled, when he is seeking for arguments to support a conclusion which he has long been fully convinced of himself; *i.e.*, he

will often use such arguments as would never have *convinced* himself, and are not likely to convince others, but rather (by the operation of the converse Fallacy) to *confirm*, in their dissent, those who before disagreed with him."

§ 4. *Material Fallacies: Quaternio Terminorum.*

1°. *Ambiguous middle.* This occurs whenever one sense of the middle term is employed in the major premiss, and another in the minor, thus—

Whoever is nervous is timid,
Hercules was nervous;
∴ Hercules was timid.

The word *nervous* is here used in two senses, viz., "timid" and "strong," and, consequently, the syllogism contains four terms, which, of course, renders it invalid. I have given an example in which the error may be easily perceived, but it must not be supposed from this, that all cases of ambiguous middle are of such a simple character. Indeed, there are many words of common use, which continually give rise to mistaken ideas in consequence of their ambiguity. Thus, the impression is very general, that the "*men of old*" were superior in wisdom and experience to those of modern times; this notion arising from the natural reverence which we feel for the opinions of "*old men*," in consequence of their longer life having enabled them to form a better judgment of the world's course than younger men can do. Of course, when the syllogism is fully expressed—"Old men are worthy of reverence; these men are men of old; therefore, these men are worthy of reverence"—we see at once that the word *old* is used at one time in the sense of *aged*, and at another, as signifying *removed from us by length of time;* and that, accordingly, the reasoning is inconsequent; but then we must remember that arguments, in practice, are elliptical, the premises being oftener hinted at, than articulately stated. A skilful sophist, therefore, will avoid anything like a definition of the terms he employs, or a full expression of his inference; trusting to the various associations, traditions, and prejudices of his hearers to supply such ideas as may be best

calculated to lead them to the desired conclusion. And in like manner, it follows that the most effectual remedy against fallacies of this description, is to insist upon a precise explanation of the sense in which each term is used. That this caution is not unnecessary, will easily be seen if we reflect upon the great number of words which are susceptible of duplicate, triplicate, &c., interpretations ; *e. g.*, *law* may mean either a command for persons to obey, or a general expression for a group of physical facts ; *same* implies identicality, and also great similarity ; *may* and *can*, sometimes signify liberty, and sometimes possibility, &c., &c.

2°. *Fallacia figuræ dictionis.* It frequently happens that *paronymous* words, *i.e.*, those which have a grammatical relation to each other in consequence of their springing from the same root, differ considerably in meaning, but yet in the haste of an argument are assumed to be of similar import. This produces what the old logicians have termed the *fallacia figuræ dictionis*, and is dangerous on account of the many variations which may be, and commonly are, given to a term in the course of a chain of reasoning, without infringing the validity of the conclusion. Thus, it would be perfectly allowable to say, " Wherever a lighted candle maintains great luminosity, the atmosphere is respirable ; in this well a lighted candle continues to be very luminous ; therefore, here the atmosphere is respirable ;" for the expressions " to maintain luminosity " and " to continue luminous " are justly treated as equipollent : but were we to say, " No designing persons are honest ; all sculptors design ; therefore no sculptor is honest," we should in reality employ four terms ; " designing " meaning *scheming* or *plotting*, while " to design " implies the *conception of some idea to be executed by an artist.*

The proper method of combating this fallacy consists in an explanation of the different senses attaching to the paronymous words.

3°. *Fallacia sensus compositi et divisi.* This, which is also termed the fallacy of composition and division, is produced whenever a term is used in one judgment *collectively*, and in the other *distributively*. A simple example is as follows :—

"Five and two are odd and even; seven is five and two; therefore, seven is odd and even." Here "five and two" means in the major premiss, those numbers alluded to distinctly and respectively; in the minor, the same taken together; accordingly, there is a case of *quaternio terminorum*.

Perhaps the most frequent method of employing fallacies of this description, is when a truth which has been separately established concerning many individual notions is sought to be inferred of them all collectively. Thus it is occasionally argued, that because the ordinary alterations of temperature produce comparatively little effect upon the physical configuration of the earth's surface, and because the same thing may be asserted of each of the natural disintegrating and abrading powers, such as tides, rivers, rain, glaciers, &c., therefore the combined operation of all together would not do more, and, consequently, that we must assume some grand cataclysm as the cause of such great changes as may be apparent.

In all cases of probability there is often a tendency to fall into the error now under consideration, and this tendency is in opposite directions. Suppose we are told that it is an even chance whether the disease upon reaching a certain stage will kill the sufferer or not; and, also, that it is an even chance whether the disease will reach that stage; we are apt to conclude that an even chance results of the person dying or not dying; whereas the chances are three to one against his dying. This is rendered evident as follows: the chance of the disease reaching a certain point is one-half of all the possible changes which may supervene; but the chance of dying is only one-half of *these*, *i.e.*, one-quarter of the possible cases; therefore the chance of not dying is three-quarters, or in the ratio of three to one. Here the probability was over-estimated, but in many instances the reverse is the case: thus, if we were to argue, that because it is improbable that the *whole* of Newton's discoveries were the results of fortunate coincidences, it is, therefore, improbable that *any one* of them was so, we should commit this error.

Archbishop Whately under this head describes what he terms the *thaumatrope* fallacy; this consists in presenting

several incompatible notions to the mind in quick succession, so as to induce the belief that they might exist together. After the Crimean war, for example, a statement was published showing the several objects which the money spent might have separately accomplished. Now, in all probability, many persons on reading the long list, and finding that this, that, and the other thing might have been done, left off with the idea that *all* of these objects together were capable of realisation.

4°. *Fallacia a dicto secundum, &c.* These fallacies arise when we conclude absolutely of a notion what is true of it only under certain circumstances; and when we conclude relatively what is only true when absolute; the latter is sometimes termed *fallacia accidentis.*

Persons occasionally fall into this error when arguing against capital punishment, forming their syllogism thus :—

To return evil for evil is wrong,
Capital punishment is returning evil for evil;
∴ Capital punishment is wrong.

Here the major premiss is only true under certain qualifications; that is to say, a revengeful *animus* is supposed in combination with returning evil for evil; whereas in the minor, the action is considered in the abstract, and without any such attendant circumstance.

Again, uneducated people are greatly astonished upon being told that the earth is nearer to the sun in winter than in summer, for their thoughts immediately run in this fashion; "the nearer we are to a hot body the warmer we must be, and therefore the earth ought to become warmer instead of colder on approaching the sun." The mistake, of course, lies in their ignorance of the fact that we only get warmer upon approaching a hot body *provided that* the rays of heat continue to strike us at the same, or at a more favourable angle.

Fallacies of this nature are very difficult to detect, in consequence of the readiness which exists to lose sight of the limitations which alone render a general law capable of being applied to some particular case. The best method of treatment is to require a rigid proof of both premises, which will always

exhibit whether the inference is legitimated by the circumstances of the case.

The false reasonings which have been described above are the principal fallacies belonging to the genus of *quaternio terminorum;* but there are many various ways of sophistication by means of ambiguity in expression, which, though not syllogistic, are often employed. Such is the practice of asking a question that may be susceptible of various interpretations according to the answer given; *e.g.*, an opponent of free-will might ask, "Am I free to do as I please?" and, being answered in the affirmative, would reply, "Then I am at liberty to kill you and half-a-dozen more if I so please." If answered in the negative, he would at once say, "Then I am controlled by necessity, and am not a free-agent." In this instance the ambiguous word is "free," which in one case is held to mean "free as regards nature;" in the other, "free as regards the laws of society." The student will have no difficulty in forming the corresponding syllogisms.

Perhaps, however, the most celebrated fallacy depending upon the ambiguity of a word, is the sophistical puzzle of Achilles and the tortoise. Its enunciation and solution are given by Mr. Mill as follows:—

"The argument is, let Achilles run ten times as fast as the tortoise, yet if the tortoise has the start, Achilles will never overtake him. For suppose them to be at first separated by an interval of a thousand feet: when Achilles has run these thousand feet, the tortoise will have got on a hundred; when Achilles has run those hundred, the tortoise will have run ten; therefore, Achilles may run for ever without overtaking the tortoise.

"Now, the 'for ever' in the conclusion, means, for any length of time that can be supposed; but in the premises 'ever' does not mean any *length* of time: it means any *number of subdivisions* of time. It means that we may divide a thousand feet by ten, and that quotient again by ten, and so on as often as we please; that there never needs be an end to the subdivisions of the distance, nor, consequently, to those of the time in which it is performed. But an unlimited number of subdivisions may be made of that which is itself limited.

The argument proves no other infinity of duration than may be embraced within five minutes. As long as the five minutes are not expired, what remains of them may be divided by ten, and again by ten, as often as we like, which is perfectly compatible with their being only five minutes altogether. It proves, in short, that to pass through this finite space requires a time which is infinitely divisible, but not an infinite time."

Another example of the same fallacy may be thus given: If at present we look forward into eternity we see that the duration yet to come is infinite; but the same state of things will obtain a hundred years hence, and as two infinite durations must be equal to each other, the futurity then, and the futurity now cannot differ; therefore the hundred years constitute no lapse of time whatever, as otherwise there would be a difference of so much between the periods in question. Thrown into a syllogistic form the argument would stand as follows:—

Two infinite durations are equal to each other,
The present futurity, and the present futurity less a hundred years, are two infinite durations;
∴ The present futurity is equal to the same, less a hundred years.

Here the major premiss involves a contradiction in terms, for it implies that two *incommensurable* things (*i.e.*, two different *infinities*) are *commensurable;* it is, therefore, inadmissible. Or the solution might pass were we to say that the middle term is ambiguous, meaning in the major premiss, "two infinite durations starting from the *same point*," and in the minor, "two infinite durations starting from *different points*."

§ 5. *Material Fallacies: Premiss unduly assumed.*

1°. *A priori fallacies.* We have now to consider those errors which arise from the assumption of a premiss, either without any proof at all, or without such proof as would be considered sufficient by both parties, if they were equally apprised of the questions at issue. And first, of those cases where there is no proof whatever of the assumed premiss.

As an essential preliminary, it must be remarked that there are some truths which we do not attain by any reasoning process,* and which, therefore, are not susceptible of proof. Thus, when a piece of brass engages my attention, I am conscious of some change which takes place in my mind, and this change I call the *sensation of yellow*, applying the name *yellow* to those attributes of the brass which produced the sensation; therefore, when I say, "This brass is yellow," I cannot abstractedly prove the statement, as I am merely asserting a subjective fact, of whose existence I alone can judge, and which is only granted by my opponent in consequence of his being affected by similar sensations. Accordingly, such truths are termed *self-evident*, and must form the foundation of all reasoning.

This consideration is the clue which guides us to the source of the particular class of sophisms at present under investigation. Men, finding that certain of their sensations correspond with outward facts, go further, and imagine that whenever any subjective state of consciousness is ascertained, there must always exist a correlative condition of the objects about which thought is concerned. Thus, Philolaus and the Pythagoreans, imagining that the nature of fire was more incomprehensible than that of earth, and feeling that whatever they could least comprehend impressed their minds with the greatest sensations of awe, concluded that fire in itself was more capable of majesty than earth, and in the disposition of the universe would occupy the most worthy place. Accordingly, they conceived that there existed in the centre of the universe a mass of fire termed the "Altar of Nature," and that, at distances varying with the different degrees of fiery composition, were ranged the heaven containing the fixed stars, the planets, and all other cosmical bodies.

Perhaps the most prevalent class of *à priori* fallacies is that which results from an inspection of the imaginative powers, it being assumed that objective existence is dependent upon

* A practical view. Compare with this the section upon Observation.

the possibility or impossibility of its being conceived by us. Dr. Clarke, for instance, in a correspondence with Bishop Butler, makes use of the following expression, "The *supposing* anything possibly to exist alone, so as not necessarily to include the pre-supposal of some other thing, *proves* demonstrably that that other thing is not necessarily existing; because whatever has necessity of existence cannot possibly, in any conception whatsoever, be supposed away." Here the statement is implied that because we *cannot conceive* it, therefore, no necessary existence can be apart from or independent of any other existence; this, of course, being an arbitrary assumption that the laws of our minds regulate the facts of nature.

Again, one of the most celebrated modern systems of philosophy was based upon this error; viz., that of Descartes, concerning whom Mr. Mill speaks thus:—"His favourite device for arriving at truth, even in regard to outward things, was by looking into his own mind for it. 'Credidi me,' says his celebrated maxim, 'pro regulâ generali sumere posse omne id quod valdè dilucidè et distinctè concipiebam, verum esse:' whatever can be very clearly conceived must certainly exist; that is, as he afterwards explains it, if the idea includes existence. And on this ground he infers that geometrical figures really exist, because they can be distinctly conceived. Whenever existence is 'involved in an idea,' a thing conformable to the idea must really exist—which is as much as to say, whatever the idea contains must have its equivalent in the thing; and what we are not able to leave out of the idea cannot be absent from the reality. This assumption pervades the philosophy not only of Descartes, but of all the thinkers who received their impulse mainly from him, in particular the two most remarkable among them, Spinosa and Leibnitz, from whom the modern German metaphysical philosophy is essentially an emanation."*

Locke, too, founds his proof of the existence of a God upon the considerations, that as (self-evidently) nothing cannot produce any real being, something must have existed from all

* "Logic," book v. chap. iii. § 3.

eternity; and that this something must be a cogitative being, because it is as impossible to conceive that every bare incogitative matter should produce a thinking intelligent being, as that nothing should of itself produce matter. This reasoning hinges upon the supposition that "what is inconceivable is impossible," a proposition which is continually being disproved as knowledge advances, and our means of investigation become greater. In fact, that great truth which is ever present with us—the action of mind upon matter—should of itself suffice to overthrow all reliance upon any *necessary* connection between subjective and objective existences.

An ordinary case of the operation of the above fallacy is to be found in the reception accorded to any account of wonderful events. Take, for example, the case of mesmerism, or spirit-rapping. One person cannot conceive the possibility of the facts being produced by ordinary means, and, *therefore*, assumes that they must be the results of supernatural agency; while another, not being able to imagine that immortal beings would, or that mortals could, give rise to such events, concludes that these cannot have occurred. In each extreme an erroneous inference takes place, founded upon a premiss unduly assumed.

Another duplicate group of errors is based upon the suppositions that nothing can be true unless some reason can be assigned for it, and that everything must be true if there exist no reason against its being so. To the former may be referred the usual objection of "*cui bono?*" which assumes that an objective fact does not exist if its practical uses are not immediately observable. To the latter belong most of the *à priori* demonstrations of physical truths, one of the best known being Duchayla's proof of the composition of forces, which rests upon the axiomatic statement that "the resultant of two forces meeting at a point, must bisect the angle between them." This is said to be self-evident, "*because we can assign no reason* why the resultant should incline to one force rather than to the other." Here, as all *à priori* reasoning is necessarily anterior to experimental knowledge, we cannot be certain but that something may exist in the natural action of two forces upon each other, which shall invariably

incline their resultant to the right or to the left; nor can any reason be assigned for the resultant bisecting the angle, rather than inclining to one of the forces. The first step, therefore, of the proof being unfounded, the remaining portions are untenable; and, indeed, it would appear generally true, that the only valid reasoning with reference to physical facts is such as may be deduced from experiment, *i.e.*, such as is *à posteriori*.

A very ancient example of the fallacy which we have just considered is to be found in the astronomical doctrines of Anaximander, who flourished at the commencement of the sixth century, B.C. He held that the earth was suspended immovably in space, *because** "being equidistant from the containing heaven in every direction, there was no reason why it should move in one direction rather than in another."

There remains but one more species of *à priori* fallacies to which I shall allude, viz., those arguments which rest upon the suppositions that an effect has but one cause, and that causes must resemble their effects. Thus, Plato,† in one of his dialogues, makes Socrates give an account of an investigation into the causes of things, which results in the conclusion that every phenomenon has its own single and separate cause—a substance being red, because a certain abstract "redness" dwells in it; large, because an abstract "magnitude" is present; small, on account of "littleness;" and so on. This opinion pervaded all philosophy until the days of Bacon, who, by his advocacy of experiment, led the way towards the admission that the same effects may be produced by different causes. At the same time, however, it is to be remarked that even Bacon himself was not altogether free from these errors, inasmuch as in his celebrated inquiry concerning the "form," or nature of heat, he assumes that the sensation of heat is always caused by the same set of conditions or attributes, whereas we now know that intense cold (and other causes) will produce a similar effect as far as our feelings are concerned. He also imagines that there must be

* Sir G. C. Lewis's "Astronomy of the Ancients," chap. ii. § 5.
† "Phædo," § 103.

a *resemblance* between causes and effects, for we find him speaking as follows :*—"Heat is a motion of expansion, not uniformly of the whole body together, but in the smaller parts of it; and at the same time checked, repelled, and beaten back, so that the body acquires a motion alternative, perpetually quivering, striving and struggling, and *irritated by repercussion*, whence springs the *fury* of fire and heat." Hence it is that, although very near the mark, he has yet failed to obtain a clear and comprehensive notion of heat, for he says,† "Again, it [that heat is a motion of constituent atoms, not of constituted bodies] is shown in this, that when the air is expanded in a calender glass, without impediment or repulsion, that is to say, uniformably or equably, there is no perceptible heat. Also, when wind escapes from confinement, although it burst forth with the greatest violence, there is no very great heat perceptible, because the motion is of the whole, without a motion alternating in the particles." Here, from the assumption that the *sensation* of heat must always be produced by heat, he concludes the absence of the latter in cases where we know it is really present. The reason, then, of Bacon's failure would appear to be that he confined himself to the investigation of the nature of that set of conditions which are capable of producing the sensation of heat; whereas he should have endeavoured to ascertain the number of different effects which might be produced by the action of heat: "the power of artificially producing an effect," as Mr. Mill says,‡ "implying a previous knowledge of, at least, one of its causes. If we discover the causes of effects, it is generally by having previously discovered the effects of causes."

I have considered these *à priori* fallacies at some length, in consequence of their universal influence, and small liability of detection. The remedy is to deny the self-evidence of the assumed principle, and require a proof.

2°. *Fallacies from pre-conceived opinions.* It often happens that men are content to accept, as established truths, assertions whose only foundations are derived from their

* "Nov. Org.," book ii. Aph. 20. Spedding's Trans. † Ibid.
‡ "Logic," book v. chap. iii. § 7. Compare with preceding remarks.

consonance with some pre-conceived opinion, or from a hasty inspection of the facts involved. And in cases where an intentional piece of sophistry is employed, the most successful plan is to mention the premiss as something wonderful and surprising ; the effect of which is that our attention is no longer directed to the question of the proposition's truth or falsity, but rather to the best method of *accounting* for the *fact*.* Thus, the Royal Society were, for a long time, puzzled by King Charles II.'s inquiry, as to the reason why a *dead* fish will not add to the weight of a vessel of water, although a *live* fish will ; and it was not until after many vain attempts to discover a solution of this marvel, that the philosophers remembered that there might be a doubt as to whether it existed at all.

Most cases of superstitions may be referred to this head ; that is to say, most instances of superstitious belief producing any effect upon the mind. How many reputed supernatural appearances would have been investigated, and their real nature detected, if the prevalent belief that such events were of frequent occurrence, had not precluded the necessary examination! And even to the present day, there are persons to be found in provincial districts, who will attribute any sudden misfortune to the operation of witchcraft, simply because they have always understood that this power was the usual cause of similar events ; never deeming it necessary to ascertain the truth of the tradition.

Indeed, there would seem to exist some faculty in the mind which renders us disposed to accept whatever is handed down in the shape of tradition, the more especially if it be of prodigious and marvellous import. Possibly the fact is, that the majority have a great disinclination to exert their mental powers more than is absolutely required for the proximate objects of their pursuits ; and, consequently, they regard with disfavour any attempt to disabuse them of erroneous opinions, as such a course would necessarily involve the exertion of accustoming themselves to new methods of belief.

3°. *Fallacies from false analogies.* Analogy is, properly

* Compare Whately's "Logic," book iii. § 14.

speaking, a "resemblance of relations;" and when "we argue from analogy," we assert that two objects which resemble each other in one point, will also resemble each other in another point, which depends in both cases, by a similar relation upon the first. Thus, we conclude that ammonium is a metal, because it resembles other metals in its formation of an amalgam with mercury; that is to say, the relation between the constituents of each amalgam, being precisely similar, we infer that they are severally composed of mercury, in combination with a metal. But were we to infer that sulphur is a metal, because heat vaporises it as well as all metallic substances, we should be employing a false analogy, because the relation of vaporisation does not necessarily determine the presence of a metal in conjunction with heat.

Accordingly, a fallacy of false analogy may be considered to exist wherever from a resemblance in one point is inferred a resemblance in another, without, at the same time, its being shown that there exists a similarity of relations between the two points.

Professor De Morgan notices the following prominent instances of this fallacy* :—"All the makers of systems, who arrange the universe, square the circle, and so forth, not only comfort themselves by thinking of the neglect which Copernicus, and other real discoverers, met with for a time, but sometimes succeed in making followers. These last forget that for every true improvement, which has been for some time unregarded, a thousand absurdities have met that fate permanently. It is not wise to toss up for a chance of being in advance of the age, by taking up at hazard, one of the things which the age passes over. As little will it do to despise the usual track for attaining an object, because (as always happens) there are some who are gifted with energies to make a road for themselves. Dr. Johnson tells a story of a lady who seriously meditated leaving out the classics in her son's education, because she had heard Shakspeare knew little of them. Telford is a standing proof (it is supposed by some) that special training is not essential for an engineer."

* "Formal Logic," p. 276.

In Plato's "Dialogue upon the Immortality of the Soul," Simmias objects that, according to Socrates' account, the soul is a harmony of the body, and that therefore, it will be destroyed when the body is, in the same manner as the harmony of a lyre ceases when the lyre is broken. But Socrates shows the fallacy of this argument, by pointing out that the same relation does not obtain between the soul and body, as between the lyre and its harmony; for, as had been previously granted, the soul exists before the body, and is, therefore, independent of it, while the harmony of any particular lyre cannot exist until the instrument is constructed, and accordingly perishes when it is destroyed.

The records of ancient astronomy abound with examples of fallacious analogies. The Pythagoreans, for instance, are reported by Aristotle, to have conceived that ten was the only perfect number, and, therefore, the number of bodies revolving round the central fire must also be ten. But nine only were visible to them; viz., the sun, the moon, the earth, the five planets, and the sphere of fixed stars; accordingly, they imagined another, which they termed the antichthon, and declared to be invisible from the earth, as it was upon the opposite side to the inhabited portion. In like manner, the distances of the several orbits were assumed to increase constantly, in the ratio of three to one, a calculation which made the sun's distance from the centre 729: this number being both a square and a cube, the sun also was said to be a square and a cube. "Finding that the distances of the planets bore, or seemed to bear to one another, a proportion not varying much from that of the divisions of the monochord, they inferred from it the existence of an inaudible music, that of the spheres: as if the music of a harp had depended solely on the numerical proportions, and not on the material, nor even on the existence of any material—any strings at all. It has been similarly imagined that certain combinations of numbers, which were found to prevail in some natural phenomena, must run through the whole of nature: as that there must be four elements, because there are four possible combinations of hot and cold, wet and dry; that there must be seven planets, because there were seven

metals, and even because there were seven days of the week. Kepler, himself, thought there could be only six planets, because there were only five regular solids."* Nor must it be imagined that these fantasies are confined to the olden times, for I, myself, have heard a clergyman seriously maintain, from the pulpit, that the number seven must be sacred in its nature, because it is composed of three and four; the former representing the Holy Trinity; the latter, man and nature, all of whose attributes and members are regulated by twos and fours.

"Another example is the not uncommon *dictum*, that bodies politic have youth, maturity, old age, and death, like bodies natural—that after a certain duration of prosperity they tend spontaneously to decay. This also, is a false analogy, because the decay of the vital powers in an animated body, can be distinctly traced to the natural progress of those very changes of structure, which, in their earlier stages, constitute its growth to maturity; while in the body politic, the progress of those changes cannot, generally speaking, have any effect but the still further continuance of growth: it is the stoppage of that progress, and the commencement of retrogression, that alone would constitute decay. Bodies politic die, but it is of disease, or violent death: they have no old age."†

Fallacies of false analogy may be shown to be erroneous, by proving that there is no causative connection between the resemblance observed and the resemblance inferred; or, in other words, that it does not necessarily follow that they must always co-exist.

4°. *Fallacies from false generalisations.* Numerous causes exist, which lead us to infer universal propositions where only particular ones are warranted by the facts of the case. Memory itself is an active agent in promoting this error; as, for instance, in the case of predictions being verified, marvellous coincidences, and the like, we only remember those occurrences where the prediction was fulfilled, or where some result followed the coincidence, and entirely forget those of

* Mill's "Logic," book v. chap. v. § 6.
† Mill's "Logic," book v. chap. v. § 6.

the contrary nature. We then enumerate the remembered cases, and conclude that the prophet is a true one, and that the coincidence is an example of cause and effect.

This fallacy often assumes a dilemmatic form, and was in constant use among the ancient Greek logicians, when engaged in their disputative tournaments. A celebrated instance is the following, which endeavours to show, from the argument of necessity, that it is of no use to strive against any occurrence, fortunate or unfortunate.

If I ought to exert myself to effect a certain event, this event either must take place or it must not;

If it must take place, my exertion is superfluous; if it must not, my exertion is of no avail;

∴ On either alternative, my exertion is useless.

Here, in the major premiss, it is assumed that for the event to take place necessarily, and for it not to do so, are all the cases possible. But this enumeration is imperfect, as the event taking place may depend upon my own exertions; and therefore, the alternative member of the premiss should be, "This event must either take place through my own exertions, or through some other cause, or not at all."

Occasionally, the answer to a dilemma is to "retort" it; *i.e.*, to propose one which shall be correlative and reciprocal. The best known of these cases is called the *litigiosus*. Sir William Hamilton's account is as follows:—"It relates to an action between Protagoras, the prince of the sophists, and Euathlus, a young man, his disciple. The disciple had covenanted to give his master a large sum to accomplish him as a lêgal rhetorician; the one half of the sum was paid down, and the other was to be paid on the day when Euathlus should plead and gain his first cause. But when the scholar, after the due course of preparatory instruction, was not in the same hurry to commence pleader, as the master to obtain the remainder of his fee, Protagoras brought Euathlus into court, and addressed his opponent in the following reasoning:—'Learn, most foolish of young men, that however matters may turn up (whether the decision to-day be in your favour or against you), pay me my demand you

must. For, if the judgment be against you, I shall obtain the fee by decree of the court, and if in your favour, I shall obtain it in terms of the compact, by which it became due on the very day you gained your first cause. You thus must fail, either by judgment or by stipulation.' To this Euathlus rejoined:—'Most sapient of masters, learn from your own argument, that whatever may be the finding of the court, absolved I must be, from any claim by you. For, if the decision be favourable, I pay nothing by the sentence of the judges, but if unfavourable, I pay nothing in virtue of the compact, because, though pleading, I shall not have gained my cause.' 'The judges,' says Gellius, 'unable to find a *ratio decidendi*, adjourned the case to an indefinite day, and ultimately left it undetermined.'"

The "horned" dilemma is also a much-renowned fallacy. It consists of the question, "Have you cast your horns?" to which, if you answer "No," I reply, "Then you have them still:" if you answer "Yes," I reply, "Then you have had horns." The error here is the assumption that you must either have had horns and cast them, or have had them and retained them; whereas, another case is possible, viz., the fact that you have never had them.

Another example is the fallacy of continuous questioning, to which the name of *sorites* is often applied. It is thus employed:—The sophist asks whether a man with so many thousand hairs on his head is bald. You answer, "No;" and are next asked whether if he had one hair less he would be bald. The same reply being given, a further diminution of one hair takes place, and so on, until you are either forced to admit that you cannot distinguish between bald and not-bald, or that they differ by a single hair. The reasoning is based upon the supposition that a man must either be bald or not-bald, whereas he may be both: and this refutation does not involve a contradiction in terms, as at first it would seem to do, for "bald" and "not-bald" being relative terms, may, when their correlatives differ, be both applied to the same object. Of course, an *exact* method of evading the sophism would be to regard "bald" as meaning entire destitution of hair; in which case there would be no absurdity in

maintaining that a single hair constituted the difference between bald and not-bald.

These will serve as a specimen of the fallacies invented by the Greeks for purposes of recreation. We will now consider the practical forms in which false generalisation appears among the ordinary reasoning processes of philosophy and common life.

The *non causa pro causa* is an error of very wide extent, and consists in imagining a causal relation between two facts which happen to occur either at the same time, or within some short interval of one another. Thus, the ancients imagined that anything which apparently moved of itself was animated, since they had observed voluntary motion to be accompanied by life in many cases: accordingly, they assumed that the stars were animated. Here, from observing a coincidence, they inferred a causal relation, and so laid down a general law which, false in itself, was the parent of many kindred errors when applied to scientific speculations. So, too, from the fact that wars or pestilences have happened soon after the appearance of a comet, it has been held that heavenly bodies of like description are the causes, or at least precursors of great calamity. In this case, a sequence was considered as a relation of antecedent and *consequent;* the technical name for such a fallacy being *post hoc, ergo propter hoc*, while the former is called *cum hoc, ergo propter hoc.*

It is not, however, to be supposed that all examples of this fallacy are of such a simple description. Thus, a country is often said to be prosperous *because* it is rich, whereas in fact, it is rich because it is prosperous: or the government and constitution must be praiseworthy, because under them the country has flourished, the truth being that it has flourished *in spite* of them.

The want of sufficient investigation frequently leads to false generalisation: iron, for instance, was supposed to be rusted whenever it came into contact with water; recent experiments have, however, determined that air, and probably carbonic acid, are also necessary to the production of this effect. Oxygen, as is imported by its name, was considered the active principle of all acids, merely because it was a

constituent of such as were then known analytically: the doctrine was but short-lived, owing to the discovery that many acids contained no oxygen whatever. And this will always be the case, where efforts are alone directed to discover the points of similarity between various bodies, instead of the attempt being made to ascertain the properties wherein they differ.

"Experience" has also much to account for as an erroneous guide: no public vehicle had been made to run at more than ten or twelve miles the hour; therefore, to travel quicker by railway could never take place. A certain law has hitherto worked well; therefore, it will never require alteration: the swans that had been seen before the discovery of Australia were white; therefore, there were no black ones. No person had met with birds without wings; consequently, until the *apteryx* was found in New Zealand, the notion obtained that all birds were thus provided; and so on, the love of dogmatising from truths within our observation to facts beyond it, being irresistible.

Of a similar nature is the employment of general propositions as such, which are only the result of a majority of cases: estimates of national character, for instance, when applied to an individual case, cannot give a correct *inference*, although, of course, the conclusion may possibly be true. When I say the Hindoos are Pagans, I mean only that most of them are so; and, therefore, were I to declare that this man is a Pagan because he is a Hindoo, my syllogism would either be invalid, the middle being undistributed, or the major premiss would be unduly assumed.

5°. *Fallacies from a False Estimation of Probabilities.* A premiss which in itself is only probable, is not uncommonly assumed as certain; or, should it be just possible, it is taken as probable. The degrees of probability are also unduly increased in many arguments, more especially where the reasoning takes the form of a sorites or epicheirema. Thus, if we were to argue that since earthquakes are possibly caused by sudden formations of steam within the earth, and since the intrusion of fused rocks and other highly heated matter into cavities filled with water would probably occasion

such bursts of steam, therefore, the probable existence of internal lakes may be inferred, we should vastly over-estimate the chances involved. So, "one of the great fallacies of evidence is the disposition to dwell on the actual possibility of its being false; a possibility which must exist when it is not demonstrative. Counsel can bewilder juries in this way until they almost doubt their own senses. A man is shot, and another man, with a recently discharged pistol in his hand, is found hiding within fifty yards of the spot, and ten minutes of the time. It does not follow that the man so found committed the murder; and cases have happened, in which it has turned out that a person convicted upon evidence as strong as the above, has been afterwards found to be innocent. An astute defender makes these cases his prominent ones; he omits to mention that it is not one in a thousand against whom such evidence exists, except when guilty." *

The chance of deception in such cases must depend, in a great measure, upon the capacity of the parties to decide upon the proper weight to be given to each probability. If numerical values can be assigned to the various statements, the conclusion is merely a matter of arithmetical computation, but it would seldom be feasible to obtain the consent of an opponent to such a course. Accordingly, the best plan is to require that each proposition shall be expressed in one of these forms—"A is more likely than not, to be D," or, "A is less likely than not, to be D:" it is a simple matter then to arrive at a satisfactory result.

6°. *Fallacy of Reasoning in a Circle.* This fallacy arises whenever one of the premises is the same in sense with the conclusion, and it is scarcely necessary to point out that its unfairness consists in the fact of assuming as already proved (*i.e.* as a premiss) the very thing which you are about to prove, viz., the conclusion. An argument might, for example, be maintained in the following manner:—"Light is certainly material, for it adds to the weight of any body which absorbs it, although in so slight a degree as to escape perception by our most exact means of investigation.

* De Morgan's "Formal Logic," pp. 275-6.

And that it does so add to the weight results from the considerations that all matter is ponderable to some extent at least, and that when any substance is absorbed by another, the ponderosity of the former is necessarily added to that of the latter." If this train of reasoning were extended by a judicious introduction of illustrative examples of each statement, with elaborate analyses of the various principles involved, it might very possibly escape the observation of many readers, that to mention in such connection the case of one *substance* being absorbed by another, is, in reality, to assume the conclusion, *i.e.*, that light is material.

7°. *Petitio Principii* is a modification of the foregoing, and occurs when the faulty premiss is "proved from the conclusion, or is such as the persons you are addressing are not likely to know, or to admit, except as an inference from it, as *e.g.*, if any one should infer the authenticity of a certain history, from its recording such and such facts, the reality of which rests on the evidence of that history." *

This fallacy is more dangerous than that of reasoning in a circle, from the circumstance that the premiss merely *depends upon*, and does not *explicitly state* the conclusion; consequently, it often requires a minute and searching investigation to detect the error. Hence we cannot be surprised upon discovering that many philosophers whose acuteness and intellectual power stand almost unrivalled, have yet fallen into the snare of *petitio principii*, or, in other words, have "begged the question" at issue. "Plato, in the "Sophistes," attempts to prove that things may exist which are incorporeal by the argument that justice and wisdom are incorporeal, and justice and wisdom must be something. Here, if by *something* be meant, as Plato did in fact mean, a thing capable of existing in and by itself, and not as a quality of some other thing, he begs the question in asserting that justice and wisdom must be something." †

It has, indeed, been urged that every syllogism is a case of the *petitio principii*, since the truth of the major premiss

* Whately's "Logic," book iii. § 13.
† Mill's "Logic," book v. chap. vii. § 2.

depends upon the truth of the conclusion. Thus, in this argument—

All horses are quadrupedal,
Bucephalus is a horse;
∴ Bucephalus is quadrupedal;—

it is objected that before we can assert *all* horses to be quadrupedal, it must be true that Bucephalus is so. To discuss the question involved would here, however, be out of place; but those students who may wish for any further information upon the subject will find such in the Appendix, Article D.

A common method of expressing the *petitio principii* is to employ words, which, although synonymous, are yet of different etymology and derivation. A happily-chosen example is thus given by Archbishop Whately: "To allow every man an unbounded freedom of speech must always be, on the whole, advantageous to the state; for it is highly conducive to the interests of the community, that each individual should enjoy a liberty perfectly unlimited, of expressing his sentiments."

The remedy for the last-mentioned fallacies consists in cutting down the chains of reasoning as much as possible, so as to bring the erroneous premiss and the conclusion into close juxtaposition, when it will not be a matter of any difficulty to discern their relation and inter-dependence.

§ 6. *Material Fallacies. Ignoratio Elenchi.*

1°. *Argumenta ad hominem, &c.* The passions and prejudices of men having an enormous influence over their reasoning powers, a skilful sophist will often, by appealing to some particular bias, convince his hearers that such and such a proposition is perfectly correct, and then maintain that being so it must be received as universally true. Now, in doing this he has merely proved the conclusion partially, *i.e.*, in so far only as his hearers are concerned; whereas he should have proved it generally, and as applicable to all classes. Accordingly, he is guilty of an ignorance or evasion of the required proof (*elenchus*), this being the distinguish-

ing characteristic of the class of errors at present under examination.

There are three principal heads contained under the first division of this class, viz., the *Argumentum ad hominem*, the *Argumentum ad verecundiam*, and the *Argumentum ad populum*. Of these, the first consists in unfairly appealing to the opinions, &c., of the individual addressed; the second, in similarly addressing the reverence entertained for old institutions and the like; the third, in apparently determining the question by exciting the passions and fancies of the populace. Thus, I might go to one man whom I knew to be a disbeliever in the results of geological science, and compel him to admit that coal could not have required vast ages for its production, by arguing that the world itself had only existed for six thousand years; this would be an appeal *ad hominem*. Again, I might go to another, and succeed in establishing the same conviction, by reminding him that surely he would never think of setting his opinion up against what had been maintained by men of such learning and genius as so and so, and so and so; here I should address my argument *ad verecundiam*. Or, I might carry this point with a mob, by telling them that the contrary opinion was only upheld by those men who were always endeavouring to deceive the poor, and to take the bread out of the labourer's mouth by new-fangled inventions, which would be an *argumentum ad populum*.

2°. *Substituting a Part for the Whole.* When a universal proposition cannot be established, it often gains admittance by the proof of its corresponding particulars. Thus, with regard to the various sciences it is frequently urged that *none* of the principles are trustworthy, *because* there has always been a difference of opinion as to facts and theory between even the most renowned philosophers. Here the assertion is true in a measure, for *some* facts and theories have undoubtedly given rise to continual discussion; but, then, we must not lose sight of the fact that investigators of all parties and shades of opinion are in perfect agreement as regards the *major portion* of the respective sciences. And this form of *ignoratio elenchi* has a still commoner modification, viz., the assumption which persons frequently make, that upon *their own* preconceived

opinions, men of science are at variance, because controversy exists as to other doctrines; this being, not an inference of the whole from a part, but of one part from another. As might be expected from its recent development, the science of geology is greatly exposed to these mistaken notions; and in reference thereto, Sir Roderick Murchison has made the following valuable observations:—"In all the grand leading *data* on which the history of geology is based, we [himself and Sir C. Lyell] are *completely united;* whether it be in recording the regular succession of formations from the oldest to the youngest, the progression from lower to higher types of life, the enormously long periods which must have elapsed in the formation of deposits, and their frequent change into crystalline conditions by that metamorphism which he has so skilfully expounded; or, lastly, in the evidences he has brought together to show that man must have coexisted with some of the great fossil mammalia. On all these subjects I hold the same opinions as himself; and I have ventured to make this explanation because it seems to me essential that the public should not run away with the idea that *because geologists occasionally disagree on points of theory, that there exists among them any divergence of opinion as to the great foundation stones on which their science has been reared.*"

In the refutation of an argument we frequently meet with examples of this fallacy: the objector shows that his opponent is mistaken upon one point, and thence concludes that the whole of his reasoning is unsound even though it may in nowise depend upon the erroneous statement. "Hence the danger of ever advancing more than can be well maintained, since the refutation of *that* will often quash the whole. . . . . Thus, also, a guilty person may often escape by having too much laid to his charge; so he may also, by having too much evidence against him, *i.e.*, some that is not in itself satisfactory. Accordingly, a prisoner may sometimes obtain acquittal by showing that one of the witnesses against him is an infamous informer and spy; though, perhaps, if that part of the evidence had been omitted, the rest would have been sufficient for conviction."*

* Whately's "Logic," book iii. § 18.

There may often be a combination of the *ignoratio elenchi* with other kinds of fallacies. Thus, instead of proving the *impossibility* of space being finite, philosophers are accustomed to prove its *inconceivability;* and the same thing occurs with regard to any limit of duration: both of these errors arising from the *à priori* belief that the conclusion proved, and the conclusion required, were in each case of equivalent import. So, too, if a supposed cause can be shown as sufficient to produce a certain effect, its existence is inferred, when the real question is, have we any grounds to warrant the supposition itself. Until, for example, Torricelli had succeeded in producing the vacuum to which his name is given, men of science were all agreed upon the statement that "Nature abhors a vacuum," a supposition which was sufficient to account for the difficulty they experienced in making a void space. The illustrious Newton himself adopted the opinion that an interstellar ether existed, not on account of those facts which have led modern philosophers to the same belief, such as the variation observable in the course of comets, and similar reasons; but because he conceived that the effects of gravity might be explained by such an assumption. In the same manner he was obliged to suppose various arbitrary properties of different kinds of matter, in order that his preconceived theory of light should be accordant with the respective phenomena of colour; but yet it must not be imagined that hypotheses are not often of very great service in scientific investigations; for when cautiously applied, and only admitted as provisional, until a more extended knowledge is attained, they form a most valuable instrument of reflection and observation. That such is the case will be at once apparent upon a mere mention of the atomic theory, which found chemistry a scattered, disjointed collection of isolated facts, and gathering the members into one organic whole, left it endowed with vitality, self-impulsive, and possessed of unfathomable power.

The fallacy of "shifting ground" should properly be ranked under this head, and occurs whenever a fresh point is raised before the former one is decided. This is also called "beating about the bush;" it chiefly happens in conversational argu-

ments, and some very good examples may be found in the "Dialogues" of Plato. For instance, in the following passage from the "Gorgias" an *ignoratio elenchi* is finely exposed by Socrates; the question being what name should be applied to Gorgias, the famous orator of Leontium :—

Chæ. But now, since he is skilled in a certain art, what can we properly call him?

Pol. Chærephon, there are many arts among men by experience experimentally discovered; for experience causes our life to proceed according to art, but inexperience according to chance. Of each of these, different persons partake of different arts in different manners; but the best of the best; in the number of whom is Gorgias here, who possesses the finest of the arts.

Soc. Polus appears, Gorgias, to be very well prepared for speaking; but he does not do what he promised Chærephon.

Gor. How so, Socrates?

Soc. He does not appear to me to answer the question that was asked.

Gor. Do you, then, if you please, ask him.

Soc. No, but if yourself would be willing to answer me, I would much rather ask you. For it is evident to me that Polus, from what he has said, has studied more what is called rhetoric than conversation.

Gor. Why so, Socrates?

Soc. Because, Polus, when Chærephon asked you in what art Gorgias was skilled, you praised his art as if some one had blamed it, but you did not say what the art itself is.

In all these cases the only plan of arriving at a satisfactory result is to come to a distinct understanding with regard to the question under debate: and if every proposition admitted or proved be closely compared with the conclusion required, it will be found that very little danger exists of sophistry proving successful.

§ 7. *Conclusion.*

Here, then, terminates our investigation of the several fallacies which most frequently occur; and by a careful study of their various natures, together with the import of the rules laid down for their treatment, we shall find ourselves in a great measure secure against the common forms of error at least; but it will easily be understood that much depends

upon the extent of individual ability, for however perfect an instrument may be, it yet requires a directing intelligence in order to perform its work, and the more ably it is guided the better it will act. Logic can offer no *panacea* against the spread of deception.

The preceding analysis has then enabled us, as far as rules go, to discover whether a given argument be fallacious or the reverse. Accordingly, we are now in a position to understand what true reasoning is, since we know what it is *not;* and we may proceed with some certainty to the consideration of the various processes which are employed in the discovery of truth. In speaking of these processes, I of course allude to those operations which form the especial province of Logic, for although the formal laws of thought must be obeyed in every possible case of observation and reflection, yet there are certain actions of the mind in which they are more particularly concerned. These will form the subject of our next chapter.

CHAPTER VI.

OF LOGIC AS PRACTICALLY APPLIED.

§ 1. *Introductory Remarks.*

The object of all science is the acquisition of truth, a subject which has as yet occupied but little of our attention; indeed, it would have been impossible to have arrived at any accurate results respecting the *laws* of thinking, if we had not abstracted from these the matter upon which they operate. Now, however, that we have obtained, as I trust, clear and accurate notions of the *mode* in which the natural constitution of our minds influences the operation of all thought, we shall be quite prepared to investigate the *results* of such influence, and to ascertain its practical effects. To do this successfully we must continually bear in mind the various principles which have been enounced during our survey of formal Logic: these relate to the three processes of apprehension, judgment, and inference, teaching us—first, that our objects of thought must be either the ideas of individuals or of classes; secondly, that any assertion concerning these ideas must take the form of a quantitative comparison; and, thirdly, that no reasoning is correct which does not conform to the syllogistic rules, which are proximate applications of the inherent mental canon. But the most transcendent product of our researches has been the firm establishment of the fact that the greatest instrument by which the mind works is *system;* it invariably strives to *arrange* the facts which it gathers, and to erect them into some connected structure; the peculiar office of Logic as a science being to secure the symmetrical adjustment of parts which compose the fabric. This truth, I make bold to say, is the indispensable key to a proper understand-

ing of the nature and working of the reflective faculties: it may be seen to underlie each separate step of our inquiries hitherto; and no explanation of the mysteries involved in the mind's search after truth can be complete unless it enters as an essential element.

Thus much premised, it will readily be imagined that unless our researches conform *strictly* to the natural laws of the intellect, we can only arrive at confusion and contradiction, instead of at truth; for, although we must always in some degree be regulated by the inherent forms of thinking, yet in many cases a considerable deviation takes place, in consequence of an imperfect acquaintance with, and analysis of the principles which should be universally prevalent. This it is which occasions the necessity for an *applied* Logic; that is to say, a science which shall point out the proper method of interweaving the laws developed by formal Logic, with the web of facts that constantly come under our notice, in such a manner that we may attain to the most perfect and correct knowledge of them. And hence it will be apparent that in so doing these laws will require various modifications, in order that they may be accommodated to the respective circumstances of the case; for it must not be forgotten that in treating upon the formal aspect of thought no account was taken of the phases into which reflection would fall when concerned with the *truth* and *falsity* of propositions. So, too, with the mathematical sciences; the principles involved are analysed upon a partial consideration only of the facts to which they are ultimately applied. In geometry, for instance, points are regarded as possessing no magnitude, lines as without breadth, circles as perfectly uniform; although for any practical purposes we must always make allowance for the many departures from theoretical supposition, which must invariably occur. And, paradoxical as it may seem, it is this very disregard of actual truth which confers upon mathematics and Logic the rigid exactness attending all their investigations; the reason being, that by removing all disturbing influences, the attention is concentrated upon such points alone as are of vital importance to the laws which regulate the existence of the science.

Accordingly, we shall find that there is not that precise distinction between the several branches of applied Logic which we found to exist in the subjects about which formal Logic is conversant. The operations run, as it were, hand in hand, presenting such an appearance of simultaneity, that it is often a matter of considerable difficulty to ascertain the exact nature of their mutual dependence and relation. They may, however, be grouped under two heads, Observation and Reflection; the first of these being amenable to the laws of conception and judgment; the second, to those of inference; while connecting them is the motive power of classification, concerning which I have so often spoken. At the same time, it will be impossible, within the present limits, to do more than indicate the best method of studying the vast subject of applied Logic; which, comprehending as it does, the generic features of all the sciences existent and to come, has required the combined efforts of the world's greatest philosophers to attain its present development; and which gives such promise of future progress as to warrant our most sanguine anticipations of results which shall excel by far all that has hitherto been accomplished.

§ 2. *Observation.*

The process of observation naturally presents itself before us as having the prior claim upon our attention; for it is evident that it must always precede reflection, as without objects to think about there would be no thought. And here it behoves us to determine more explicitly than heretofore the import which attaches to the phrase "objects of thought;" as otherwise some ambiguity of expression would be likely to occur in consequence of the idea generally attached to the word "object." This, in ordinary parlance, is held to imply some substance or existence which produces an impression upon our minds, but, when used philosophically, may also signify the impression itself. If, for instance, I say, "Heat is a most mysterious thing," I may either mean the *sensation* of heat, or the *cause* of that sensation; and it is with words of this description that confusion commonly arises. Thus, in Mr. Mill's elaborate and masterly "System of Logic," from

which I have often had occasion to quote, there is the following passage: "But from these and similar generalisations countenance and currency have been given to attempts to resolve, not motion into motion, but heat into motion, light into motion, sensation itself into motion;" where "heat" and "light" would appear to mean the outward *causes* of the respective sensations, and not the *sensations* themselves; for otherwise there needs to be no distinction drawn between "heat," "light," and "*sensation;* but yet, a few lines further on, we read, "All I insist upon . . . is, that it shall not be supposed that by proving these things [*i.e.*, "that certain motions in the particles of bodies are among the *conditions* of the production of heat or light"] one step would be made towards a real explanation of heat, light, or sensation. . . . Let it be shown, for instance, that the most complex series of physical causes and effects succeed one another in the eye and in the brain to produce a sensation of colour; . . . still, at the end of these motions, there is something which is not motion, there is a feeling or sensation of colour." Here, indisputably, Mr. Mill is combating the supposition that the *sensation* of heat, light, &c., is motion, a proceeding, however, altogether irrelevant to the question in hand (as at first stated), viz., whether motion is the *cause* (or "among the *conditions*") of such sensations. An example of this nature is the more instructive, as it will be easily supposed that when so acute and profound a philosopher is led into a confusion of *expression* (for one cannot imagine that there is any confusion of *thought*) by the ambiguity above-mentioned, multitudes of inferior writers will continually mistake the point to be proved, and will involve their arguments accordingly.

Now the word "phenomena" would appear to be better adapted than any other for expressing the notion intended to be conveyed by the phrase "objects of thought;" it being seldom used but in a strictly philosophical sense. We shall, therefore, in the first place, ascertain the nature of those phenomena concerning which our thoughts are occupied, having in view the determination between such as are, and such as are not, the subjects of direct observation.

Every phenomenon is either subjective or objective; either

a condition or state of our mind, or a condition of something apart from our mind. Any knowledge that we may possess of the former must obviously be the result of intuition or immediate perception; but as regards the latter, the operation is by no means so simple, even in the most familiar and, apparently, incomplex cases. Thus, when I touch a piece of iron and say, "This iron is hot," the train of thought from which the judgment results is of the following character:— I look in a certain direction, and am immediately impressed with those sensations of sight, which, from prior experience, I have concluded to be always produced by a series of phenomena termed "iron." I extend my hand in the same direction, and receive two sets of sensations, one consisting of "hardness," &c., thus corroborating the evidence of my eyes as to the existence of "iron," and the other reminding me of sensations similar to those antecedently produced by cases of "heat." I, therefore, feel certain that a series of phenomena exists before me, which resembles a large class of other series in its capacity of raising up a particular sensation, known by the name of "heat;" a conviction which I express by saying, "This iron is hot." Here, then, a process which would be commonly called an act of observation, is seen to consist of two steps: first, the perception of certain sensations, and secondly, an inference based upon the existence of these sensations; consequently, the truth of the statement must depend upon the correctness of the reasoning. Nor is this analysis by any means unimportant, for it frequently happens that a supposed, but non-existent, fact is taken for granted, merely because it has been *observed;* whereas the truth is that it was *inferred.* There is, for example, a beautiful experiment in optics, where a revolving wheel is rendered visible by means of flashes of light, so adjusted that the wheel is once illuminated during each revolution; the effect of this being that although the wheel revolves at the rate of several hundred times a minute, it yet appears to be standing perfectly still; and so perfect is the illusion, that even to imagine it as such is almost impossible. The explanation of this is, that the means employed in the experiment produce sensations which are indistinguishable from those produced by a wheel standing perfectly still,

and this latter phenomenon we accordingly infer to be the case; an instance of fallacious *à priori* reasoning, where the supposition that an effect has but one cause is unduly assumed.

Accordingly, we find that the only phenomena which can be the subject of direct observation, and concerning which we may arrive at *truth* by means of direct observation, are subjective; that is to say, the *existence of certain sensations* is the only thing of which we can be sure when the observing faculties are alone employed. At the same time, it would serve no useful end if we were to push this doctrine to its extreme limits, and more especially in a treatise like the present, which cannot enter very minutely into the ultimate processes of thought; suffice it, therefore, to have called the attention of the student to a point so interesting and essential, as by so doing it may be reasonably hoped that he will have been put sufficiently on his guard to prevent any chance of error arising from this cause. In future, then, I shall not care to be rigidly precise when making use of expressions which involve the process of observation; but I shall still hope to be philosophically exact, for, as we formerly saw when treating upon the parallel case of the so-called immediate reasoning compared with syllogistic inference, a preliminary examination and subsequent neglect of some mental operations is by no means incompatible with a correct exposition of logical science.

Assuming, then, that a comparatively loose sense may be attached to the notion of observation, we have next to inquire into the nature of the process as logically required for the purposes of science; and, as science is merely concerned with the acquirement of truth, it follows that the end of logical observation should be the formation of correct conceptions with reference to those phenomena which are the objects of thought.

Now, the first requisite is that our notions should be *clear;* that is to say, that they should be determinedly fixed; and as the method of arriving at general conceptions, or, in other words, the process of abstraction, has already been described as regards its formal aspect, it now remains to introduce the element of material truth. The main feature of the process consists in comparing together a number of individual objects

with a view to ascertain their points of resemblance, and then conceiving a class composed of any number of objects which might happen to possess those points; and this duplicate operation can only be correctly performed by attending to the following considerations. Let us endeavour, for example, to trace the formation of the conception "metals." We meet with certain individual objects, say gold, silver, and tin, and we wish to obtain such a general notion as may enable us to remember the sensations produced equally by each one of them, and by no other thing. We accordingly analyse the complex impression of each individual, *i.e.*, we concentrate our attention successively upon each separate one of the sensations, and note those which were produced indifferently by gold, silver, or tin. Extending our language a little, we may describe ourselves when so doing as observing the attributes which were possessed in common by the three objects, gold, silver, and tin. Suppose us, therefore, to remark that they all possess weight and hardness; we might here pause and give the name of "metal" to the combination of those two attributes, but were we to do so, we should find that such an idea was not complex enough to distinguish gold, silver, and tin from many other objects, such as stone, wood, &c.; that is to say, we should not have formed a *clear* and *distinct* idea of a metal. We, consequently, resort to observation again and again, until we have abstracted such a combination of attributes, that gold, silver, and tin are the only objects which we know to possess it; we can then *clearly* recall the sensations produced by a "metal." This capability, however, would only belong to ourselves, who had performed the above process; and were we to employ the name in communicating with other persons, it would be necessary for us, in the first place, to define exactly what we mean by the term, as otherwise they might attach a different signification to it, and might include the notions of things totally different from gold, silver, and tin. Here, then, we have two sources of obscurity, imperfect abstraction, and imperfect definition; the remedy for the former being renewed observation; for the latter, those rules which were laid down when treating upon definition in the second chapter of this work.

The second requisite for correct conception is that our notions should be *appropriate;* that is to say, that they should have a proper relation to the question in hand. There can, of course, be no general rule laid down as to what this relation must be in every case, for that can only be settled by the specific end which we propose to ourselves; but yet it may be remarked that the attributes observed should all have some distinct reference to the principle of division adopted in the particular science under investigation. Thus, in the example chosen above, our notion of "metal" would include such marks as hardness, weight, ductility, and malleability, if we were occupied with mechanical researches; to these would be added the capability of forming a base by union with oxygen, if chemistry were our object; while the study of physics would necessitate the inclusion of "great conductive powers" among the metallic attributes.

If, therefore, we take care that our conceptions are clear and appropriate, ascertaining at the same time that our senses do not deceive us as to the real existence of the properties observed, we shall so far be in the possession of truth, and our consequent reflections will rest upon a sound basis. This is all that can be done by observation, and as the nature, conditions, and end of this process have now been described, it would appear that nothing further remains to be added: before, however, I quit this portion of my subject, it may be advisable to offer a few remarks upon the *mode* of observing.

We have already seen that, strictly speaking, subjective facts only can be *directly* observed; but that no inaccuracy need result if we admit the application of the process to certain objective phenomena. It is these latter which will now be considered. And, first, we must note that observation may be direct or indirect; that is to say, we may either employ our unaided senses, or we may make use of instruments to assist us. In the former case, the chief truths at which we arrive are those of quality; in the latter, of quantity. Thus, by making use of the eye alone, we can form an approximate notion as regards the height of an object, and this will be nearer to the truth according as our practical experience is greater; but to know it exactly, we must employ some

measure. Here, in one case, we could merely be sure that the object possessed *some* height; in the other, we could tell the exact *amount*. Or again, a ray of light appears to ordinary observation as perfectly homogeneous and white; Saturn, too, is a mere luminous point; but the application of a prism reveals the existence of various colours in the sunbeam, while a telescope discloses the vision of a far-off world encircled with a glittering belt; and with the perfection of the instrument advances, *pari passu*, our powers of observation. In the solar spectrum, for instance, Fraunhofer was just able to ascertain the duplex nature of the line D, but, recently, M. Gassiot, with his magnificent spectroscope, has resolved it into at least sixteen distinctly defined lines. And the same thing took place with regard to Saturn; the employment of a higher telescopic power showed that what at first seemed to be but one belt, was in reality two. It will thus be seen that when the capability of *exact* admeasurement by means of instruments is asserted, all that can be strictly understood is our power of fixing definite limits in one direction at least; and hence we gather that the best method of forming correct conceptions is by observing as precisely as possible, both the *nature* and *amount* of the properties wherein bodies resemble or differ from each other. We must, however, bear in mind the fact that although two attributes differ very much in quantity, yet, if they are alike in *quality*, they will produce exactly the same *kind* of sensation, although varying in degree; consequently, we must place them together in the same class. In our example of "metals," gold, silver, and tin all possess the mark of "weight," but in very different quantities, this difference being one of their distinguishing characters as individuals; and, therefore, if we were to meet with some other object, such as lead, and were to recognise in it the existence of the same kind of attributes as those which we abstracted from gold, silver, and tin, to constitute the notion of a metal, we should at once refer it to that class, although each mark might present a totally different appearance as regarded its amount.

Experiment may also be considered as an act of observation; for although usually the result of reflection, yet in itself

it differs not from the ascertainment of attributes or properties by means of an instrument. In the present place, therefore, we shall merely consider it from the latter point of view, and shall defer all inquiry into the motives for its performance until we come to treat upon the processes of which it is a necessary accompaniment. A *clear* notion then can only be obtained from experiment, by closely observing the nature and amount of the difference between the respective state of things before the commencement, and after the termination of the act; while as to what is an *appropriate* notion, must be wholly determined by the particular object for which we performed the experiment. Thus, if I wished to ascertain the mechanical effects of heat upon red glass, I should notice that the latter became *plastic* when very hot; but were I investigating its optical properties, I should confine my attention to the fact that its *colour* had changed from red to green.

And here it may be remarked that Logic can no more make men good observers than she can make them good reasoners, except in so far as the adherence to rules laid down in strict accordance with mental laws will tend to a healthy exercise and invigorating discipline of the intellect. It is a just saying that "practice makes perfect," but all the watering and attendance possible will never produce an oak from a thistle-seed; and so the most that can be done is to cultivate to the best advantage whatever has been originally implanted. Accordingly, the end of observation—*i.e.*, the attainment of correct notions—will be greatly promoted by the *habitual* exercise of the faculty in accordance with the suggestions given above; but it is necessary that a good observer should also possess a retentive memory and wide experience, as otherwise his ideas would soon become confused, or they would not accord so closely with actual truth as to be of much avail for practical purposes.

§ 3. *Reflection.*

1°. *Of Laws and Causes.* As yet our attention has been confined to the ascertainment of what amount of truth may be acquired by the employment of observation alone. We

have found that even when the widest latitude is allowed, the results so obtained are merely a collection of separate ideas, these ideas being composed of various resemblances and differences. But, numerous as such notions may be, they constitute a very small portion indeed of existent truth. We have certainly coasted along the shore, and surveyed its general features; the vast interior, however, still remains unexplored. That is to say, having collected the facts, we must now examine into their connection, and in so doing we shall perceive that the laws of inference are alone adequate to the task: therefore, without a previous knowledge of them, our labours would but terminate in confusion and disappointment.

The bare *existence* of phenomena has hitherto been the subject of our analysis; we must now endeavour to justly appreciate the *modes* in which they exist; and as the order of time is here alluded to, it will at once be seen that a list of these modes may be easily made; in fact, there are but two—*coexistence* and *sequence*, for phenomena must either occur together, or in succession. Which order obtains in any particular case is, of course, determined by observation; the right understanding of such order is the office of reflection.

Now, in our sphere of thought, we cannot but observe that a certain principle of *uniformity* prevails, more or less, in every occurrence which comes under our notice. Thus, a heavy body if unsupported falls to the ground; a pressure, when not sufficiently opposed, is followed by motion in the object pressed; death invariably succeeds the infliction of certain wounds; the explosion of gunpowder is always accompanied by the extrication of heat and light. All these facts must impress themselves strongly upon our attention. But in other cases the uniformity is by no means so general; it is only some men, for instance, who have black hair; it is only occasionally that we meet with natural springs whose waters are more highly heated than the surrounding earth; it is not always that a west wind is accompanied by rain. These considerations lead us to a distinction between uniformities, which we accordingly regard as necessary, or casual; as invariably occurring, or happening, as it were, by chance. The grounds upon which this distinction may be correctly

made will shortly be explained; at present we are concerned simply with the fact as it stands.

The impression produced upon our minds by the regularity with which many phenomena recur is that nature works according to some uniform necessity, this being termed a *law;* and, consequently, we speak of certain uniformities as being *laws of nature.* Thus, we say that for matter to possess weight as one of its attributes is a natural law; that the orderly constitution of nature renders it necessary for water to tend to find its level; that motion unopposed must continue for ever. It is, however, only to truths of this ultimate description that the term "laws of nature" is applied; many uniformities which at first sight might appear of the same description, being in reality *results* of the former. Thus, that the moon should revolve about the earth as a centre, would, from the perfect uniformity of the revolution, seem to be a natural law; but closer investigation shows that the motion takes place in obedience to three separate laws applied under certain circumstances. In fact, we might predict *à priori* such an effect as resulting from given conditions, but we could not predict the conditions themselves antecedently to experience.

And this leads us to a cognate consideration of great importance; the determination of what is implied by the expression "resulting." Here, of course, the cases are limited to uniformities of sequence—that is to say, those phenomena which we always observe to occur in regular succession. The names usually applied to any duplicate set of this description are *cause* and *effect;* reference being made to a law of nature, which must now be explained, viz., the law of universal causation. Some idea of the mode in which we arrive at this law may be thus given: we observe throughout nature that whenever anything occurs there have always existed some antecedent conditions; and we also observe that certain conditions are invariably followed by definite consequents. If I feel unwell I know that some abnormal state of my body has previously supervened; if I thrust my hand into the fire I know that sharp pain will immediately succeed; when rain falls we feel certain that the suspension of water in the air

preceded the storm; or, should we pass a strong current of electricity through a piece of thin platinum wire, we are assured that the latter will speedily become red-hot. Experience of this nature leads us to the conclusion that if anything have a beginning it has also a *cause;* that is to say, some condition, or group of conditions, must have previously existed, in virtue of which existence the phenomenon in question was produced.

But we must not suppose that *all* uniformities of sequence, how universal soever they may be, are cases in which the law of causation operates; for it will have been observed that the name of *cause* is only applied to those conditions *in virtue of whose existence* the effect *necessarily* follows—to those phenomena without which other phenomena would not occur, but which being once posited the other *must* spring into being. Therefore, when the sequence is merely casual, and there is no connection of necessity between the events, we cannot refer them to the law of causation: for example, when summer invariably follows spring; autumn, summer; and winter, autumn; it could not be said that one season was the *cause* of the next, for then the two requisites of cause and effect would be violated; it being possible for a perpetual summer to exist, or for winter to immediately succeed summer without the intervention of autumn, in consequence of some change taking place in the earth's position with regard to the sun, or in the present physical configuration of the earth.

Nor must any mere arbitrary limit be placed upon the signification of "cause;" we must not make a selection from the conditions upon which an event depends. It is true that this is almost invariably done, as when the prick of a needle is said to be the *cause* of the pain which I feel; or when iron is said to be dissolved *because* sulphuric acid is poured on it; or, again, when the metamorphism of certain rocks is said to be produced by the action of fire. In all these cases there is an omission of necessary particulars. Thus, in the first, I should not feel pain from the prick unless I were alive, and possessed a certain organisation, &c.; in the second, the iron would not be dissolved if, in addition to the mere presence of the acid, there did not exist a certain attraction between

oxygen and iron, oxide of iron and sulphuric acid; while in the third, some physical properties of matter, such as polarity, &c., are equally essential with heat to the production of the effect. Also, in every case there must necessarily exist a negative condition, besides those which are positive; this being the absence of counteracting causes, that is, those conditions which tend to produce a contrary effect. Thus, in the present state of the solar system, the earth keeps at a certain distance from the sun; but were the latter body and his attendant planets in their common motion through space to enter some resisting medium, the earth, although acted upon by all its former influences, would yet fall into the sun by reason of the new condition preventing the old causes from producing their wonted effects.

Accordingly, the vulgar sense of the word *cause* does not express its philosophical import; and this ambiguity it will be necessary to bear in mind, as, from the convenience attaching to limited notions, it is often expedient for the attainment of the purpose in hand to consider *that* the cause, which really is but a portion of the conditions requisite for the production of the effect. For instance, when heat is said to cause the expansion of a bar of iron, we mean that heat is the condition whose introduction amongst other conditions gives rise to the change in volume; or, in the example given above, the resisting medium would be said to cause the earth's fall into the sun, not because it could produce such an effect when acting alone, but on account of its enabling gravitation to act under less opposition from centrifugal force.

It will now be seen that a *law of nature* is nothing more nor less than the expression of the relation existing between any single cause and its effect. By applying this doctrine to the truths first cited as natural laws, we may obtain a clear notion of its application. That matter possesses weight, then, means that wherever the entity termed matter exists it will possess the attribute of weight; but it may be said that matter would not be matter without possessing weight, and that, therefore, weight would be simultaneous in its existence with matter. This, of course, opens up the question as to all cases of cause and effect, for who can say that the conse-

quent does not commence to exist at the selfsame moment that its conditioning antecedents are complete; so that the argument, if valid, would show that there is no such thing as sequence in any case of causation. Now I am very far from denying the cogency of such reasoning, but this I do say, that for all practical purposes we may safely admit the notion of succession. As, therefore, "weight" is but the attraction subsisting between material bodies, we may assume that were some new matter to be created it would have no weight *until* it attracted, and had been attracted by other matter; this operation taking place by virtue of a natural law that renders its occurrence a matter of necessity. And so with the second and third laws; whenever a gravitating fluid exists there results an equal pressure in all directions, this fact being expressed by the statement that water tends to find its own level; or, lastly, whenever motion exists alone, it continues for ever. In all these cases the antecedents are the causes, the consequents are the effects, and the necessary connections between the respective pairs of phenomena are the laws.

2°. *Of Induction.* When speaking of observation, I had occasion to remark, that the existence of objective facts was a matter of inference based upon our "experience" of subjective phenomena; and again, in the preceding division, we found that the distinction between necessary and casual uniformities, was also originated by the accumulations of observation, *i.e.*, by "experience." What is the meaning of this phrase must now, therefore, be discussed.

We have just synonymised "experience" by the expression "accumulation of observations;" but when we say that a certain proposition is warranted by experience, we do not mean that our inference rests upon the whole mass of observations which we have ever made, but that a consideration of such observations as relate to the fact in question, has disposed us to infer, as a general truth, the uniformity which constitutes the judgment. That is to say, by reflecting upon certain separate observations, we are induced to believe in the existence of some law. The operation of the mind by which this result is produced, has been named Induction, and may be defined as the process of assigning causes for effects.

Now, as it is by induction that we arrive at laws and causes, which, as shown above, constitute by far the major portion of existent truth, it follows that in an exposition of applied Logic this operation of the mind must occupy the most important position. And, accordingly, it will be advisable to treat as fully as our limits of space will allow, upon the nature and method of correct induction; or, in other words, upon the mental laws which impel us to generalise from experience, and upon the quantity and quality of that experience, which these laws render necessary for the establishment of a correct inference.

Let us, then, in the first place, retrace the steps by which we have arrived at any proposition, and endeavour to ascertain upon what fundamental ground they all rest. Suppose we take this judgment, "The earth is a globe;" the question then comes, what are the premises from which such a conclusion was derived? These we know to be "every body which in certain positions would cast such and such a shadow upon the moon, and which could be circumnavigated, &c., is a globe" (U) for the major, and "the earth possesses these attributes" for a minor; and as the latter is the direct product of observation (loosely), it remains to be considered how the former was obtained—that is to say, we must next examine our grounds for stating that *all* globes possess the properties in question. This judgment cannot, of course, be the direct product of observation, for even had we been able to examine every globe at present existing, the proposition directly resulting would not be equivalent to the one above stated, which, being universal, must apply to all globes which have ever existed, or will exist henceforth, in addition to those of present entity. It must, consequently, depend upon reflection, *i.e.*, upon a process of reasoning from observed facts; and as we have seen in formal Logic, that all reasoning whatever may be reduced to syllogisms, it results that the judgment, "all globes possess such and such properties," is a conclusion drawn from previously established premises. Of these Observation gives one, viz., "This, that, and the other globe, have been found to possess the attributes above mentioned;" and, therefore, since the syllogism is valid, the other

must be to this effect, "Whatever may be predicated of this, that, and the other globe, may be predicated of *all* globes;" which means, "Whatever attributes are found to accompany this, that, and the other globe, will be found to equally accompany every other globe." Pursuing a similar course, we next arrive at the following syllogism:—

A case of a certain particular uniformity is a case of the corresponding general uniformity,

The case of this, that, and the other globe being found to possess the attributes in question, is such a case of particular uniformity;

∴ The case of this, that, and the other globe being found to possess certain attributes, is a case of *all* globes being similarly marked.

Now beyond this we cannot go; that is to say, we cannot assign any premises which would necessitate as a conclusion the last-mentioned major-premiss. Accordingly, for all purposes of Logic, we must assume the principle thus stated to be a fundamental law of the mind, by which, from ascertaining one truth, we are compelled to believe another. Its enunciation in the above syllogism is manifestly of a very partial character, as a due comprehension of its import would necessitate a complete explication of the phrase, "a *certain* particular uniformity;" but this is the province of inductive *method*, and is foreign to our immediate purpose, viz., the treatment of inductive *elements*. To firmly establish these, we must next show that the law at which we have just arrived, is really of the nature claimed for it, *i.e.*, fundamental. At the same time, it will not be necessary to proceed any further with an investigation of the mind's ultimate constitution, as to do this would be to intrench upon the domain of metaphysics. But we must rather endeavour to show, that all other principles of reasoning, or axioms, are merely differentiations of the foregoing law. And as so wide a subject could not be entirely discussed in our limited space, it will be sufficient if we confine our attention to the axiomatic "law of causation," and to any one of the mathematical principles; say, "if equals be added to equals, the wholes are equal."

We have already taken occasion to remark that the first of

these axioms is the result of experience,—that it is our observation of *some* cases of antecedence which induces us to believe that *all* events are the effects of causes. But unless there existed some necessary mental law to legitimatize this inference, we should obviously be unable to rely upon its correctness, as then the only conclusion that could possibly be trustworthy, would be that resulting from an inductive syllogism of the kind mentioned in Formal Logic; in other words, we should be unable to proceed beyond the limits of our actual experience. Consequently, our observations of various instances of cause and effect require the aid of the inductive law before we can deduce any such general statement as that under consideration, and which is often termed "the assertion of nature's uniformity."

The second axiom, although usually considered fundamental, is, strictly speaking, of more complex derivation than the law of causation; for the latter is but one step removed from the inductive principle, while the former is separated by two syllogisms. These may be thus expressed:—

1°. Certain particular uniformities legitimatize the inference of the corresponding general uniformities,
Some cases of equal magnitudes being the same number of coincident magnitudes, constitute the required particular uniformity;
∴ It is true that "all equal magnitudes are all coincident magnitudes."

2°. All equal magnitudes are coincident (U),
All sums of equals are coincident;
∴ All sums of equals are equal.

I have stated the second argument as a simple syllogism, although it would be possible to show that it is of an epicheiramatic nature, the minor premiss being a conclusion based upon the major. But this matters not in the present place, where we are only concerned with proving that the canon, "if equals be added to equals, the wholes are equal;" or, as otherwise expressed, "the sums of equals are equal," is dependent for its adoption upon the inductive law, and has *per se* no *locus standi*. An inspection of the above reasoning will show that we have effected our purpose, and that the

fundamental grounds of the mathematical axioms are observation conjoined with reflection; the knowledge acquired by experience being developed and increased by the laws which regulate our minds.*

It will be remembered that when treating upon syllogistic inference, we found the fundamental law of that process to be *directly* inapplicable to many forms of reasoning, insomuch that for practical purposes it was developed into a series of proximate rules, which were sufficient to test the validity of all arguments, without our being at the trouble of effecting a reduction to syllogisms of the first figure. The same thing occurs in Applied Logic. We must differentiate the law of induction to such an extent, that the proximate canons thus obtained may enable us to judge correctly as to the truth of the propositions at which we arrive, and may render any reference to original principles unnecessary. But since such a differentiation can only be accomplished by completely appreciating the meaning of the inductive law; it follows that the doctrine of inductive *method* will next claim our attention.

Now, the truths at which we arrive by means of induction, are of two kinds: either the statement of general laws, *i.e.*, an assertion of natural uniformities, without any exact discrimination of cause and effect, such as mathematical axioms, &c.; or the knowledge of special laws, which consists in the assignment of definite causes for definite effects, and *vice versâ*, as, for instance, the truths of astronomy or chemistry. And, first, we will inquire as to what kind of experience warrants us in concluding the latter class of truths.

The cause of any effect is, as already stated, the whole of the conditions which unite in producing it; but this definition being too wide for my present purpose, I shall in the following remarks understand by a *cause* "that circumstance which produces some definite change in a set of antecedent conditions:" thus, a bell while sounding remains in exactly the same state as when it was silent, with the exception that its particles are vibrating: this vibration, then, is termed the

* Some additional exposition of this subject will be found in Appendix D.

cause of the sound. So much being premised, I shall now investigate the mode in which we may determine the cause of any phenomenon.

It will of course be evident, that the cause must exist amongst the conditions which compose the phenomenon in its totality; for otherwise, there would not be that connection of necessity which we have seen is essential in every case of a sequence obeying a law. If, therefore, we have two or more instances of the effect which differ from each other in some things, but all agree in certain conditions, these latter are the only things which exist in every instance of the effect, and, accordingly, in them the cause must be sought. We thus obtain the canon of Agreement, which runs as follows:—

1°. The cause will be found among the circumstances in which two or more instances of the effect agree.

Or,

A uniformity which is observed in two or more instances, may be considered as invariable and necessary.

If, for example, we found that gold and silver both conducted heat, we might say that the cause of such a power was included in the possession of metallic attributes, since that would be the sole circumstance in which the instances agreed; or, in accordance with the above variation of the canon, it would be allowable to hold that every metal is capable of conducting heat. We can, however, only infer *absolute* laws, whether the observed effects be relative or absolute; thus, from gold and silver being heavier than water, we cannot conclude that all metals are so, as the phenomenon investigated was not precisely the same in each case, *i.e.*, the two metals differed in the amount by which they were heavier than water. But since they definitely agreed in possessing weight, we may affirm that property of all metals; indeed, it forms one of the purely metallic attributes.

The information acquired by means of the above canon is seldom satisfactory, as we are only able to ascertain the precise cause in those very rare cases where the phenomena agree but in *one* point; so that although truth is acquired, yet it is so vague and indefinite as to be oftentimes prac-

tically worthless. In the example just given, all that we can be sure of is, that the power of conducting heat is in some manner connected with the possession of metallic attributes. If, therefore, we would arrive at a clearer notion of causes, we must seek for some method of singling out the desired conditions from among the set which have been presented to us by the canon of agreement.

Now, as an effect necessarily follows from its cause, except where there is a counteracting cause (which would be a new condition), we may conclude, that when, of two cases, one contains the phenomenon under investigation, and the other does not, the cause is not to be sought among the conditions common to both. If, therefore, we observe a case which does not exhibit the phenomenon, but all of whose conditions are contained in the set pointed out by the canon of agreement, we shall be enabled to eliminate these conditions from the number among which the cause is to be found, and thus our limits of search will be much narrowed. A sufficient repetition of this process will eventually point out with definition and certainty the law which we are endeavouring to discover; and thus it may be seen that in this we possess a method of complete efficacy, in all cases susceptible of its application. The canon which regulates the operation, and which is termed the canon of Difference, may be enunciated in the following manner:—

2°. The cause will be found among the circumstances in which an instance, composed of a portion of the conditions set apart by the canon of agreement, but not containing the effect, differs from an instance which is composed of all such conditions.

The example chosen for exhibiting the method of agreement is not adapted to illustrate that of difference, for we are unable to select any body which is totally destitute of conductive powers as regards heat; we must consequently make use of some other instance, and leave this to be dealt with hereafter. Suppose we wished to discover the conditions upon which our hearing the sound of a bell depends: we should learn by the method of agreement that all bells, however they might differ in shape, size, tone, &c., yet, when sounding,

agreed in vibrating and in being placed in the atmosphere. Next, we should endeavour to obtain an instance of a bell being struck, and thus thrown into vibration, but under different circumstances, which might result in the sound being no longer heard. This would be effected by striking the bell in the exhausted receiver of an air-pump, when we should be unable to hear any sound; and the condition in which the instances differed, *i.e.*, the presence of an atmosphere, would consequently be the cause of sound being audible.

We have just seen, however, that the method of difference is always inapplicable when no instance of the phenomenon's non-occurrence can be obtained; a circumstance which would be a great hindrance towards the acquirement of truth, were we unable to find any remedy. But this is not impossible, for although the canon of difference is much more powerful than that of agreement, yet it is similarly restricted, as, by its means, we can only discover absolute laws, without any reference to quantity. Accordingly, we must now endeavour to obtain some knowledge of the means whereby the latter object may be accomplished.

Among the uniformities of invariable sequence which come within our observation, we cannot fail to remark the existence in most cases of a certain ratio between cause and effect; between antecedent and consequent. Thus, a small dose of arsenic produces no visible effect upon a man's constitution; a larger dose makes him ill; and a still greater quantity kills him; while beyond this limit no extension of its deadly effect can occur. Or, in blasting rocks, the work done is altogether dependent upon the weight of gunpowder used; assuming, of course, that the *modus operandi* remains the same. We are, consequently, led to the conclusion that the effect is always directly proportional to the cause, and that a variation in one is attendant on, or followed by, a corresponding variation in the other. But in one of the examples mentioned above, this law does not appear at first sight to be universally true, for we have said that however large the quantity of arsenic may be, it can do no more than produce death; and this leads us to the consideration that, for practical purposes, apparent limits are often assigned to the law

in question, a cause being still regarded as the same with reference to the effect, although some condition has disappeared. In the case alluded to, it is evident that the complete antecedent of death is composed of the poison capable of acting upon some organism, together with the organism itself in a *state of life;* but it is equally evident that when death has supervened, the conditions existing are such as not to be capable of producing a similar effect, for the object to be destroyed no longer exists. The law is, therefore, seen to be universal, when we adopt the strict signification of "cause" as formerly explained; but at present we may safely assign those limits which are rendered necessary by our immediate apprehension of "invariable sequence."

The canon then of Proportional Variation runs thus:—

3°. Whenever a phenomenon varies proportionately to the variation of some condition, there exists a uniformity of necessary sequence between them.

The employment of this doctrine will enable us to arrive at truths which would otherwise be inaccessible. Take, for instance, the determination of the properties which cause metals to conduct heat. We find that no two possess equal conductive powers, and, also, that no two possess similar molecular constitution; in like manner we ascertain that any variation in the arrangement of the particles in a single metal occasions a corresponding variation of its conductive power; but as our means of observation do not at present enable us to assign any distinct ratio between the variations of each separate mode of constitution, and the induced variations of conductivity, we can only conclude that some uniformity of dependence exists, without attempting to fix its precise law. I have purposely chosen an example of this extreme nature, as by it is shown that the canons of induction will at all times suffice to assure us of the right path to pursue, even in cases where the imperfect state of science precludes our attaining any immediate proximity to ultimate truth.

We have now discussed the three principal canons of induction; there are, however, various practical corollaries and rules which spring from them, and as it would be impossible to consider each of these separately in a treatise like the

present, I think it best to proceed at once to the investigation of the other processes employed in the attainment of truth, and then to give an account of some scientific discoveries which will exhibit in a concrete form the development and application of such doctrines as we have examined.

3°. *Of Deduction, Hypothesis, and Verification.* By *induction* we are enabled to arrive at general truths. When these are employed for the ascertainment of any particular truth not previously established we are said to *deduce.* Thus, induction has taught us that all beings which possess the attributes of humanity are mortal; therefore, when a fresh nation is discovered in Central Africa, we may with certainty predict that they are subject to death. Or, from the laws which have been found to regulate the respective motions of the bodies forming the solar system, astronomers can accurately foretell eclipses and other results of the changes that continually take place in the relative positions of the sun and its attendant planets. These judgments are the product of deduction based upon prior induction, and it is, therefore, commonly maintained that the sole and ultimate foundation for all our knowledge of truth is experience, *i.e.*, our observation of particular facts. This view, however, we have shown to be but partially correct, as the primary operation to which we traced the process of induction, consisted of a deduction from observation referred to a general principle—of a syllogism, in fact, and, as such, amenable to the laws of mediate inference. Formal Logic, therefore, is the ultimate judge of all the mental operations with which thought is concerned; and deduction is the first step made in our search after truth. Consequently, the title of the present division of Reflection must be held to refer to a secondary and derivative process of deduction, employed for the purpose of utilising the laws determined by the original *deductive* operation which, on account of its strongly marked and distinguishing features, has received the name of Induction.

In all scientific inquiries it is seldom found that single causes are in operation; but as the inductive method is better adapted for the ascertainment of individual than of general laws, it usually makes us alone conversant with the relation

subsisting between solitary cases of antecedents and consequents. Here, then, we have the special province of deduction pointed out, viz., the determining of the effects necessarily resulting from a combination of causes. And as this is done by a series of syllogistic reasonings, it will not require analysis in the present place, as we have already considered these at full length in the chapter upon syllogisms. I may, however, remark that the finest examples of the deductive method will be found in the mathematical sciences, such as geometry and algebra, where the vast body of general truths are all derived from a proper union of a few simple laws.

I have said that by induction we usually arrive at individual laws, *i.e.*, at laws which are applicable to single or to few phenomena. By this I would be understood to mean, that the laws thus acquired will, in general, merely suffice to explain the sequence in the cases under direct consideration, or in cases essentially similar, being quite unserviceable when we attempt to extend their sphere. Thus, the phenomena of falling bodies led at first to the inference that it was the *nature* of most terrestrial matter to move downwards; and a consideration of the planetary motions resulted in the conclusion that orbits were circular, because of the perfection supposed to inhere in that species of curve. And even when more correct notions prevailed, laws were for long entertained, which assumed different sequences of causation as existing between celestial and terrestrial motions, it being reserved for Sir Isaac Newton to point out by a process of deduction, that the one law of gravitation was the regulating principle of the solar system, extending its influence from the determination of the cosmical cycles, to the least important of the movements taking place upon the earth's surface.

It is not, however, always possible at the first blush to obtain such laws by induction, as may suffice when developed by the deductive method, for the full appreciation of the phenomena under investigation. In such cases the resort of the philosopher is hypothesis, which, when properly employed, will often suggest those observations that are capable of affording the grounds required by induction; but as regards the formation of hypotheses, all rules are of little avail, for

success must entirely depend upon that natural sagacity, the possession of which is in a great measure the characteristic of genius. At the same time, it is quite possible to indicate the manner in which a hypothesis should be treated, and to point out the purposes it will best serve.

A hypothesis, then, is the supposition of some law which shall serve to explain such sequences as have become the objects of observation. It is, therefore, employed when the cases in question are incapable of the particular collation required by the inductive canons, or their corollaries; that is to say, when the facts cannot of themselves lead to any determined truth; and when once the hypothesis has been framed it should be used deductively; first, with a view to ascertain if the results thence arising correspond with the actual instances observed; and in the next place, to infer the existence of new phenomena. which may then be sought for, and which, if discovered, will render probable the truth of the supposition. This duplicate process is termed verification, but, as just described, cannot be considered complete; the hypothesis being spoken of, as thereby shown to be "probably," not "certainly," true. In many cases, however, an extension of verification may amount to a perfect induction, for if we first prove that the supposed law is of such a nature as to account for the phenomena already observed, and to predict the occurrence of fresh examples; and, then, in addition, show that no other supposition could offer a similar explanation, we shall satisfy the requirements of the canons of agreement and difference, thus establishing the hypothesis as a true law.

It will also be seen that in verification we have a most important adjunct of deduction, for when the latter process has, from the results of induction, arranged a system of laws, we may test the accuracy of these by employing them to explain observed phenomena, and to foretell facts that yet remain to be discovered; and if in this manner we are led to satisfactory conclusions, we shall be enabled to strengthen the primary induction by means of the additional evidence thus obtained. Experiment is perhaps the most common method of verification, and deals exclusively with the prediction of sequences; in fact, every operation of practical life

is an experiment by which we confirm afresh the laws deduced by the various sciences. Our ships and buildings are all constructed in accordance with the principles of mechanics; the art of agriculture is successful proportionately as it conforms to chemical laws; the safety of every sailor depends upon a special application of mathematics; and thus we continually become more and more convinced of our ability to attain truth by means of a strict adherence to those mental laws which it is the office of Logic to discover and explain.

4°. *Of Analogy.* The framing of any hypothesis is never a work of chance, *i.e.*, a mere guess, in the strictest sense of the word, but is usually suggested by some circumstances of the observed phenomenon. Of these circumstances, the only one which it will be necessary to mention here, is analogy, which, it will be borne in mind, has already required our attention, when we were discussing the subject of fallacies. It was then described as the similarity of relations, and arguments both false and true were noticed as being founded thereupon. We must not, however, suppose that complete certainty may be attained by analogical reasoning; as at the best, one can only infer a very strong degree of probability for the law deduced; this being treated hypothetically, *i.e.*, as a *provisional* principle, until fully verified, when it of course assumes the position of an established truth. It will, therefore, be obvious, that the cogency of any argument from analogy must depend altogether upon the special features of the case; and, accordingly, I shall not attempt to give an exposition of the various analogical methods. The student may, however, gain a very good idea of analogy in general, by carefully considering the following *résumé* of a celebrated problem, viz., whether the planets are inhabited.

In the first place, it is requisite that we should be put in possession of a certain number of facts, upon the basis of which we may found our argument. And, for reasons which will shortly appear, these facts should consist of similarities observed to exist between the earth and the other planets. Accordingly, a judicious use of the telescope has enabled us to accumulate the truths which follow. We find that Mercury,

Venus, and Mars, are each provided with an atmosphere; and so distinctly is this visible, that we can clearly perceive the morning and evening twilight on Venus; we find, too, that clouds exist in these atmospheres, thus showing the existence of meteorological phenomena, such as rain, hail, snow, winds, &c., upon the respective planets. Again, it is ascertained that Mercury, Venus, and Mars revolve upon their axes, giving rise to the regular production of night and day, the respective lengths of these differing only by a few minutes from that which obtains upon the earth; and, as the axis of Mars is inclined to the plane of his orbit at an angle very similar to the obliquity of the terrestrial ecliptic, it follows that as far as the sun is concerned, the seasons in both planets do not vary to any great extent, while very good reasons exist for supposing the same thing to occur in Mercury and Venus also. Nor does much variety obtain in the supply of light and heat to the four bodies of which we are speaking, whether reference be made to its uniformity or intensity; and, as regards the effect of gravity, it is found that the weight of bodies upon the surface of Venus are very similar to those upon the earth, and that weights upon Mercury and Mars are about half as heavy. Lastly, the existence of continents and seas has been observed upon Mars; his polar regions being eternally covered with snow, the limits of which extend in winter and contract in summer.

Having thus found that certain similarities exist between the earth and its neighbouring planet, we must, in the next place, ascertain what bearing these conditions have upon the phenomena of life. Nor does this require a lengthened investigation, for it will be immediately apparent, that on the earth all life is exactly adapted to, and depends upon, such physical circumstances as the existence of light, heat, air, water, night, day, the succession of the seasons, the surface configuration of land and sea, &c., &c. Now, in their relation to life such as ours, the physical conditions of Mercury, Venus, and Mars, may be considered as identical with those of the earth, and, accordingly, we form the following syllogism based upon analogy, or, in other words, upon a similarity of relations :—

Terrestrial phenomena are accompanied by life (A),
Terrestrial phenomena are the phenomena of Mercury, Venus, and Mars (U);
∴ The phenomena of Mercury, Venus, and Mars, are accompanied by life (A).

If the premises are here granted, the argument is perfectly true, for A U A is a valid mood, and the proper method of refuting the syllogism would be to show the falsity of the minor premiss, which asserts, that as far as the present argument is concerned, the physical phenomena of Mars, Venus, and Mercury are the same as those of the earth.

With reference to Jupiter, Saturn, Uranus, and Neptune, the argument is of less force, as although they possess atmospheres, alternations of day, night, and the seasons, together with water, &c., yet a consideration of their bulk, and other reflections, show that if life does exist upon them, it must differ considerably from terrestrial being: at the same time, it may be proved that there need be no greater variation between the life upon those planets and that upon the earth, than exists between the inhabitants of our torrid and frigid zones. Accordingly, the analogical relation is much weaker, thus casting greater doubt upon the admissibility of the minor premiss.

5°. *Of Chance and Probability.* In the preceding remarks occasion has been taken to introduce the subject of probability; and as absolute certainty is of very rare occurrence in practice, it would not be advisable to close this notice of the reflective processes, without adding a few words upon the amount of belief which may be attached to certain judgments.

This leads us to consider a certain restriction which attends the application of the canon of agreement. Its enunciation, it will be remembered, is as follows:—"A uniformity which is observed in two or more instances, may be considered as invariable and necessary;" this referring to a law of causation existing between the common antecedent and consequent of the instances in question. Now it is evident that, for anything we can tell to the contrary, it may be necessary for the *whole* of such antecedent to exist before the phenomenon can be produced; and therefore, at the best, we can only generalise

as to cases precisely similar in every respect to the observed instances. The law thus induced is termed an empirical law, and is of no use for the explanation of phenomena. But then again, it may happen that an effect is capable of being produced by a variety of causes; that is to say, that the common conditions of the instances may co-operate successively with the respective points of difference in giving rise to the same effect, assuming, of course, that we know of no connection between the various instances, all of them being equally independent. In such a case the effect would be termed the result of chance, as distinguished from law; this meaning that we see no reason why the common conditions should be joined to any particular antecedent, or why, if so joined, the phenomenon should occur.

It, therefore, becomes a matter of some interest to discover under what circumstances we are entitled to infer a *causal* instead of a *casual* uniformity, when the canon of agreement is alone used, and when, consequently, we are ignorant of any relation subsisting between the instances except such as are by this means discovered. These circumstances are usually determined in the following manner:—

Suppose a series of instances among which we know none of the causes in operation, nor any necessary connection whatever; as for instance, the case of a box containing balls similar in every respect but colour, these being drawn out separately by a person blindfolded. The question comes as to what probability there is for any one colour to be drawn rather than another. Now the supposition being that any one ball is as likely to be drawn as any other, it follows that if there were only two, black and white, the chances would be equal; and so, in like manner, would it be if there were two of each colour, or three, or four, or, in fact, any number. But suppose there were two white to one black, then it is evident that of all the drawings possible, two would be in favour of white, and only one in favour of black, so that the "chances" are two to one against black; and in general it will be found that, as far as mere casualty is concerned, the probability of any event occurring may be measured by the proportion of the number of cases in favour of such event to the total number

possible ; thus, in the first of our examples the probability of white was one-half, or one out of two ; in the second it was two-thirds, or two out of three.

By similar investigations mathematicians have determined that the chance against any particular casual event *recurring* a given number of times in succession, is as the number of possible events raised to a corresponding power to unity. Thus, four to one are the odds that heads will not be thrown twice in succession when a coin is tossed ; nine to one that heads will not occur three times successively, and so on. Also it has been shown that the chance of an event already observed again occurring may be represented by a fraction whose numerator is composed of the instances observed, increased by one, and whose denominator is the same number increased by two ; the chance against recurrence being that fraction, which, together with the chance for, would amount to unity. If, for example, I knew nothing of astronomy, and were to observe a comet appear for six successive nights in a certain portion of the sky, I might reasonably conclude that the chances for the phenomenon being again apparent on the next night were as seven-eighths to one-eighth, *i.e.*, as seven to one.

Thus it will be seen that every increase in the number of times of observing the uniformity under similar conditions lends a vast amount of additional weight to the belief that there is some law concerned, and that the phenomenon is not a product of chance ; accordingly, it is considered generally requisite that before an empirical law can be laid down as such there must have been a sufficient number of instances observed to have eliminated chance ; that is to say, the uniformity must have occurred a greater number of times than can be accounted for by the operation of chance.

The importance of these considerations will be at once evident, when we reflect that the law of causation and all axiomatic principles are the products of the canon of agreement alone, and are, so far, but empirical laws. As, however, their limits of space and time comprehend all that we, as human beings, are concerned with, we may act upon them with a perfect assurance of their certitude.

6°. *Examples of Reflection. a. The Discovery of Neptune.* I shall take for my first concrete illustration of the reflective process that most stupendous achievement of modern astronomy, the discovery of the planet Neptune, which, presenting as it does one of the completest triumphs of the human intellect, is pre-eminently calculated to display the vast accession of power which original sagacity acquires by the proper development of the reasoning faculties.

The process of verification first led to the above-mentioned discovery, and in the following manner. The Newtonian law of gravity, together with the laws of motion, had been found sufficient for the explanation and prediction of planetary movements until, in 1781, Uranus was discovered by Sir W. Herschel. This afforded a fresh test of those laws, and astronomers were not slow in availing themselves of the opportunity; for not only did they compute tables, and construct ephemerides by which the future places of Uranus might be predicted, but they also calculated the positions which it had occupied in past times, and so were enabled to identify it with a supposed fixed star that had previously been observed at various periods by Flamsteed, Bradley, Mayer, and Lemonnier. At the same time, however, it was found that the planet had not occupied the *exact* positions which were deduced from the above-mentioned laws, as its observed places deviated sensibly from the calculated ones; it, therefore, became a matter of importance to ascertain the cause of such deviations; and for this there were two hypotheses open—either the deviations were caused by chance, such as errors of observation, or by the operation of some definite and regular law. Accordingly, it was not until about 1840 that a sufficient number of observations had been accumulated so as to eliminate chance, and then the facts stood as follows. The planet was known to move in obedience to three causes—the laws of motion, the attraction of the sun, and the perturbations induced by the proximity of Jupiter and Saturn; but a deduction from these failed to explain the whole of Neptune's movements, for from 1795 to 1822 the observed places continued, year by year to be in advance of those calculated, while from 1822 to 1830-1 a regression took place until the

tabular and observed positions agreed; and this regression uniformly continued in the years succeeding 1830-1, so that the hypothesis of some regular disturbing cause was the only one tenable, chance being eliminated, and the planetary deviations being too small to cast any doubt upon the validity of the gravitative and dynamical laws. At this point it was that Messrs. Le Verrier and Adams took up the question simultaneously, each, strangely enough, being in complete ignorance of the other's investigations; and their first resort was to analogy; for, knowing that the irregularities in the orbital movements of other planets were referable to the perturbing effects of mutual attraction, they concluded that the same thing obtained with regard to Neptune; that is to say, they inferred that all those disturbances which could not be accounted for by the influence of Jupiter and Saturn were caused by some planet hitherto unknown. But this was by no means sufficient, as mathematical considerations proved that any one of an infinite number of planets, varying in mass, distance, &c., would be capable of producing the deviations in question, so that the problem admitted of numberless solutions. It, therefore, became necessary still further to limit the question before any hope of arriving at a satisfactory answer could be entertained; and this was done by a wider application of analogy. It was assumed that the unknown planet resembled those already discovered, in the plane of its orbit being nearly the same, in the direction of its motion being similar, in its orbit being an ellipse differing but little from a circle, and in its mean distance from the sun agreeing with Bode's law of progression. Also, as it was assumed to be a planet of the solar system, it was supposed to move in accordance with Kepler's laws, and from all these hypothetical conditions, the mass of the planet sought, together with the elements of its orbit, could be calculated very precisely. This was accordingly done, and the results possessed a very high degree of probability, in consequence of the cogent analogical reasoning upon which they were based; so much so, indeed, that until something further could be obtained, the deduction might be assumed as true for all practical purposes. But it will at once be evident that the ques-

tion was susceptible of a complete settlement, as it was only necessary to calculate the position which the supposed planet would occupy on any given night, and then to look for it in that place, when, if the hypothesis were correct, the planet would be immediately *seen*. Consequently, "on the 23rd of September, 1846, Dr. Galle, one of the astronomers of the Royal Observatory at Berlin, received a letter from M. Le Verrier, announcing to him that the longitude of the sought planet must then be 326°, and requesting him to look for it. Dr. Galle, assisted by Professor Encke, accordingly did 'look for it,' and found it that very night. It appeared as a star of the eighth magnitude, having the longitude of 326° 52′, and consequently only 52′ from the place assigned by M. Le Verrier. The calculations of Mr. Adams, reduced to the same date, give for its apparent place 329° 19′, being 2° 27′ from the place where it was actually found." Thus the elimination of chance, combined with analogy, suggested a hypothesis, which assumed the rank of an established truth when the deductions from it received a complete verification.

b. Kirchhoff's Researches on the Solar Spectrum. In this case the phenomenon observed was the occurrence of various dark lines in the spectrum of a sunbeam, and to discover the cause of these constituted the question at issue. The method of Difference was first employed by showing that solid or liquid bodies, when heated to incandescence, emit rays which produce spectra differing only from the solar spectrum in the absence of dark lines: the inference drawn from this fact being that the cause of such lines must be sought among the conditions in which the two cases differed. Now it was evident that both kinds of rays proceeded from incandescent bodies, and also passed through the terrestrial atmosphere, but the solar rays, in addition to this, had to pass through the sun's atmosphere, and, therefore, in this latter condition the sought cause should be found; a conclusion which received additional strength from the analogical arguments of Sir David Brewster and Dr. Gladstone. In the next place, it had been found by experience that all transparent bodies emit, when incandescent, only those rays which they absorb when cold; thus, red glass if strongly heated appears green, yellow glass

appears purple, &c. It was also known that the spectra of incandescent *vapours* consisted simply of bright lines upon a dark ground; so, combining the two facts together, Kirchhoff conjectured that vapours comparatively cold would absorb the rays corresponding to such bright lines. Accordingly, he tried the experiment by causing the rays from a solid luminous body to pass through the vapour of sodium, and obtained a spectrum similar in every respect to that produced when no vapour was interposed, with the exception of two dark lines; these were found to be identical in position with the two yellow lines composing the spectrum of luminous sodium vapour. But, on examining the solar spectrum, two dark lines were therein perceived which corresponded exactly with those resulting from the absorptive power of vapourised sodium, and, therefore, it was evident that the presence of such a body was one of the conditions of the solar atmosphere. In a similar manner it has been ascertained that iron, nickel, calcium, magnesium, barium, copper, &c., all surround the sun in a state of vapour, and thus produce those dark lines which formed the subject of investigation. The argument may be thus thrown into a train of syllogistic inference:—

1. The facts observed being the production of uniform spectra by incandescent solids, and spectra with dark lines by the solar rays, we have the inductive syllogism, U U U:—

The difference of conditions is the cause of the difference of phenomena,

The solar atmosphere is the difference of conditions;

∴ The solar atmosphere causes the difference of the phenomena, viz., the dark lines.

2. A deduction from a law previously established, A A A:—

All transparent bodies when cold will absorb those rays which they emit when incandescent,

Sodium vapour is a transparent body;

∴ Sodium vapour when cold absorbs those rays which it emits when luminous.

3. This last conclusion is verified by experiment, and the facts now observed being the presence of two dark lines, both in the spectra from solar rays, and in those from incandescent

solids surrounded with sodium vapour, we construct a deductive syllogism in A A I, Fig. 3, based upon the two former :—

The cause of the two dark lines is sodium vapour,

The cause of the two dark lines is the solar atmosphere ;

∴ Some portion of the solar atmosphere is sodium vapour.

I may mention that I have here purposely abstained from the consideration of more causes than one being capable of producing the same effect, as, otherwise, the argument would become too perplexed for my present intention, viz., to give an example of simple logical processes when practically applied.

It would be easy to adduce many more instances of scientific discoveries, but the above, if thoroughly studied with a due recollection of the principles discussed in this treatise, will suffice to exhibit the method of analysing a complex argument into its logical elements ; and the student will be able to select for himself such other events in the history of philosophy as are well adapted for this purpose, thus putting his knowledge of mental laws to the test, and discovering what those particulars are which will be most advantageous for his individual pursuits.

§ 4. *Conclusion.*

Having now reached the end of our subject, it may not be amiss if we briefly consider the results which ought to flow from the study of a dissertation upon Logic. In the first place, we should be able to grasp the science as an organic whole, distinctly apprehending the nature of those inherent principles which compel the mind to think in one uniform manner, and forming a clear notion of the dependence which exists between them and our every act of acquiring knowledge. Secondly, we should have become accustomed to concentrate our attention upon the *process* of thought, without any reference to the matters about which it is employed. And, lastly, we should have learnt so to apply the practical principles which are deduced from a consideration of the primary mental laws, that without yielding to the blandishments of error, we may certainly attain the great temple of truth.

But I shall have written to very little purpose, if the reader be not in a position to recognise that great fact, the unity of philosophy, which, when once fully understood, lends a significance to all scientific truths, such as they otherwise would not possess; for it is the office of Logic to show that every ramification of our knowledge, however diverse, may ultimately be traced back to one parent stem; and, so far from the various sciences differing as regards their nature, it becomes a question as to whether the subjects concerning which they treat have any more than an apparent incompatibility. Therefore, he who would act in a truly philosophical spirit, must not remain satisfied with a crude, empirical acquaintance with isolated groups of facts, but should endeavour to obtain such general principles as may embrace them all; for then, not only would he obtain a more perfect knowledge of those facts themselves, but he would be enabled to gather many new truths, which, by any other method, must be lost for ever. And this may be observed in all the branches of learning: while the various facts are looked at in themselves, and by themselves, no great progress can be made; but immediately that laws, even of a comparatively limited nature, are discovered and borne in mind, then a vast impulse is given, the effects of which will speedily become apparent. At the same time, we should remember the intimate connection of reflection with observation, and endeavour not to cultivate one at the expense of the other.

Logic, then, may be considered as abstract philosophy, that system of which all other sciences are but the concrete manifestations; and, therefore, he alone can be justly termed a philosopher who has made himself acquainted with the laws that regulate the working of his own thoughts. But a mere acquaintance, in the ordinary sense of the word, will by no means suffice; for, as Archbishop Thomson observes, "philosophy does not exist until the mind of the student begins to work for itself with the principles it receives historically; to decompose and to compose anew, to criticise the arguments employed, to essay at least to push the confines of truth farther into the wilds of error and ignorance, and to leave her a wider territory." In other words, we should not

become accustomed to acquiesce as a matter of course in the assertions with which we meet, nor to imagine that the subject is capable of no further development; but, by actively applying the powers of our own minds to the elucidation of the question, we should endeavour to ascertain the precise amount of truth which inheres in the principles laid down, and to add something, however small, to the previously accumulated store of knowledge.

The end, accordingly, at which all should aim who desire the proper cultivation of their intellects, is rectification and progression—the correct adjustment of opinions already entertained, and the establishment of views more wide and lofty; for, as this can only be done by a recourse to the latent powers of their own understandings, it will assuredly result both in a surprising accession of vigour to the individual mind, and in great benefits to the world at large. Nor can it be doubted that the practice of thought, when duly controlled by the regular operation of its formal laws, must highly conduce in the promotion of mental calmness and sobriety: no longer led astray by the influence of passion, or deceived by the representations of the senses, the well-ordered intellect, secure and undisturbed, reviews by the light of necessary truth those facts which come under its notice, and delivers judgment in strict accordance with the immutable laws of nature.

In conclusion, I would remark that by far the noblest subject of human investigation is the human mind. The science of astronomy may give rise to emotions of awe and sublimity as we contemplate the vast infinitude of space, with its myriads of worlds and systems of worlds; geology may astonish us with its record of the marvellous forms of life which have successively inhabited the earth; the physical sciences may endue us with power so prodigious, as to become almost miraculous; but yet, the fascination which attends every inquiry into the nature of our own being, must always cause the study of mental philosophy to take its place as the most mysterious and attractive object of all our speculations.

APPENDIX.

A.

On Judgments.

In the body of this treatise, I have (p. 27) described judgment as "the act of determining by comparison, whether one idea is or is not included within another," and have referred it to the motive faculty of classification. But as the subject is one of great importance, and has much influence upon a due appreciation of logical science, I deem it advisable to append some further observations which shall enable the student to form a completer notion of the import which attaches to predication.

Now the most useful manner of introducing such remarks will be to criticise the most important objections which have been made to the above views; and for this purpose I shall select the following passage from Mr. Mill's "System of Logic," (vol. i. p. 104). "This theory appears to me a signal example of a logical error very often committed in logic, that of ὕστερον πρότερον, or explaining a thing by something which presupposes it. When I say that snow is white, I may and ought to be thinking of snow as a class, because I am asserting a proposition as true of all snow: but I am certainly not thinking of white objects as a class; I am thinking of no white object whatever except snow, but only of that, and of the sensation of white which it gives me. When, indeed, I have judged or assented to the propositions, that snow is white, and that several other things are also white, I gradually begin to think of white objects as a class, including snow and those other things. But this is a conception which followed, not preceded, those judgments, and

therefore cannot be given as an explanation of them. Instead of explaining the effect by the cause, this doctrine explains the cause by the effect, and is, I conceive, founded on a latent misconception of the nature of classification."

In the expression "when I say that snow is white," Mr. Mill evidently alludes to the formation of such a judgment *before* the conception of a class of white objects, for he says shortly after, "This [white objects as a class] is a conception which *followed*" the establishment of similar propositions; and as this is the ground upon which he charges the classificatory doctrine of judgment with error, his argument will be sufficiently refuted by showing that it is impossible to form the proposition "snow is white," before recognising white objects as a *class*.

And first, let Mr. Mill himself be brought forward as a witness: he says (vol. i. p. 30), "When we say snow is white, milk is white, linen is white, we do not mean it to be understood, that snow, or linen, or milk, is a colour. We mean that they are *things* having the colour." Therefore the meaning of the proposition is, so far, that snow is a white object. It must next be shown that we cannot think of "*a* white object," by itself, but that we always think of "*some* (or all) white objects," that is, of a class; and this may be done by a reference to the process of abstraction. For, as was seen at an early stage of our logical studies, it is necessary that such a process should be completed before we are able to possess any common notion or abstract term; and, therefore, the idea "white" is the result of comparison, reflection, abstraction, generalisation, and denomination, the first four of these being simultaneous, a fact which will become evident upon pushing our analysis a little further. Thus, suppose we had never obtained the idea of "white," or of any other common notion, and that we met with the object "snow:" the impression produced upon our senses would be a combination of such sensations as solidity, granular structure, absence of what is commonly termed colour, &c., but we should find it altogether impossible to separate this compound idea into its various parts; consequently, the only notion obtained would be an *intuition*, and we should be unable to form any other judgment than that "snow is snow." Immediately, however, that we met with any other intuition, say "milk," we should receive an immense acquisition to our knowledge; we should instinctively, as it were, compare them, and thus

perceive that although the two objects resembled each other in some respects, yet that they differed in others; that, for example, in one object a solution of molecular continuity was easily observable, while in the other such a condition did not obtain; that snow offered some resistance to a change of shape, while milk did not; but also that the intuitions produced by both were partly indistinguishable. This fact would compel us to recognise that the idea ("snow") which we had previously considered as simple, was in reality compound; or, in other words, that it was capable of division: for we should have sensible evidence that a part of it could exist without the remainder. Accordingly, we should see that snow and milk were separate objects, but yet, as far as our minds were concerned, partially identical; that is to say, we should recognise a *class* composed of two individuals. Now the whole of the preceding mental action would take place in equal progression, for with the commencement and advance of comparison, would commence and advance, *pari passu*, reflection, abstraction, and generalisation. But after this was concluded as far as would suit our more immediate purpose, we should take some measure to prevent our forgetting its results, and this would be the imposition of an abstract term, together with its correlative concrete. In the present case we should term that sensation in which both intuitions agreed, "whiteness," and then we should form the proposition "snow and milk are white objects;" or, in more detail, we should say, "snow is white, and milk is white." Therefore, it will be evident that no judgment (excluding such as are tautologous) can be formed without the conception of a class composed of at least two individuals; although, in most cases, a general name cannot be imposed until after the comparison of many objects, and the recognition of a proportionately larger class. But it must here be borne in mind, that when once we have gone beyond the idea of unity, there is no definite limit which we can impose upon our powers of imagination; and, accordingly, no sooner is a general notion conceived, than we regard the class as hypothetically infinite. This hint will, I hope, prove sufficient to prevent the opinion being entertained that classification is *merely* "an arrangement and grouping of *definite* and *known* individuals;" and that the doctrine above stated implies the theory, "that when names were imposed, mankind took into consideration all the individual objects in the universe, distributed them into parcels

or lists, and gave to the objects of each list a common name, repeating this operation *toties quoties*, until they had invented all the general names of which language consists." (Mill's "Logic," vol. i. p. 105.)

It has now, I apprehend, been irrefragably demonstrated that the classificatory doctrine of predication rests upon valid grounds, and that the objections considered above are untenable. Indeed, so simple and natural is the theory, that even Mr. Mill himself, when not engaged in actual combat therewith, implicitly affords his support to it, as witness the following passage:—"A child learns the meaning of the words *man* or *white*, by hearing them applied to a *variety* of individual objects, and finding out, by a process of *generalisation* and *analysis* of which he is but imperfectly conscious, what those different objects have in common." (Vol. i. p. 39.) If this mean that an abstract notion and its concrete cannot be formed from the observation of a single object—and certainly neither from the passage itself, nor from the context can I suppose any other signification intended—then the whole question at issue is granted, since the idea of a class is merely the conception of two or more individuals resembling each other in certain respects.*

I have already taken occasion to protest against Archbishop Thomson's exposition of judgment, but my remarks must not be held to refer to anything beyond the terminology employed, as it is possible that the doctrine so ambiguously put forth, may, in all essential points, be that of classification. Thus, speaking of the proposition "All men are animals," Dr. Thomson says, "We mean by our judgment, not that men and animals are just the same things, but that men are *contained in* [*sic*] the wider class animals." ("Outlines," p. 151.)

And as regards my own statement (p. 28) that the copula of a proposition signifies "the identicality of the subject and predicate, such *identicality* being, however, *limited* by the form of the proposition," I must refer the reader for a more complete explication of its import, to the foregoing analysis of the manner in which common terms are formed.

* It may be proper to observe that in the above quotations many of the italics are my own.

B.

On the so-called Immediate Inferences.

These are such arguments as were discussed under the heads of opposition, conversion, and coincident junction; and since a universal misconception appears to exist regarding their real nature, it may be worth while to present the reader with some additional information upon this point.

And first, it will be necessary to prove that an *inference* takes place in these processes, for many logicians exclude them altogether from the sphere of reasoning. Now, I cannot do this better than by adopting the words of Archbishop Thomson, a philosopher to whom the science of Logic is under very great obligations; and therefore, without further apology, I proceed to quote the following remarks:—

"Some logicians refuse the name of inference to this and similar processes [those named above], on the ground that 'there is in the conclusion no new truth, nothing but what was already asserted in the premises, and obvious to whoever apprehends them.' That the conclusion is *virtually* asserted in the premises, is true not only of these immediate inferences but of all syllogisms whatever; even in the inductive, the mere consequence—the act of concluding—brings in nothing which is not known potentially as soon as we have the whole grounds before us. So that the objection proves too much; as it would disqualify a set of inferences which no one thinks of rejecting. If, however, there is absolutely nothing new—if the concession of the premiss is not only a virtual, but an actual and express declaration of the conclusion, there is no inference, but mere repetition. But who can say that 'no unjust rulers are good' is a bare repetition of 'all good rulers are just?' In the one we affirm, in the other deny; in the one the subject of thought is 'good rulers,' in the other, 'unjust rulers.' They are, in these two points at least, distinct judgments, and as the passing of the one makes it possible, without further observation or decision upon facts, to collect the other, there is an inference. In many such cases, it is true, the inference is so obvious, so certain to occur upon the first glance at the premiss, that it seems needless to draw it out; but all the inferences we are about to specify are used from time to time, and this entitles them to our consideration."

The above passage will suffice for the establishment of the arguments in question as inferences; it now remains to prove that they are *mediate* inferences. And here it may be remarked as somewhat singular, that so acute a thinker as Dr. Thomson should have made such a near approach to the whole truth, and yet should have grasped but a portion; for it will be observed that although he clearly perceives the conclusion to result from a process of reasoning, he still maintains that it is dependent upon one premiss only; a doctrine which probably arises from the very fact that arrests his attention, viz., the obviousness and transparency of the inference—this rendering him loth to suppose the existence of a syllogistic deduction in so simple an operation, as, in like manner, it prevented the older logicians from admitting the presence of any reasoning whatever, no matter how supposedly direct it might be.

I shall, accordingly, proceed to enunciate the several principles upon which the validity of the inferred propositions rests; and if they are obviously essential, the doctrine here advocated must be admitted as established.

1. Opposition:—

a. Contradictory. *Any two classes must be either mutually and wholly exclusive or mutually and partially inclusive.* This canon is necessitated by the laws which regulate our thoughts, and therefore, as far as Logic is concerned, must be considered fundamental. Its meaning is that we cannot think of any two classes, except in one of the manners stated; and from it are developed these judgments:—"If E be true, I is false;" "If E be false, I is true;" "If I be true, E is false;" and "If I be false, E is true;" which respectively serve as major propositions in any particular case where this kind of opposition may be employed, the judgment operated upon serving as a minor. Thus, admitting the fact that "no men have wings," we must also admit that the statement "some men have wings" is false; for,

If E be true, I is false,
E ("no men have wings") is true;
∴ I ("some men have wings") is false.

Now, a moment's inspection will show that unless the major be here assumed, there can be no inference.

b. Contrary. *Neither the mutual and total exclusion of two classes, nor their mutual and partial inclusion, can be thought at the same time with their mutual and total inclusion.* By

development from this canon we obtain such majors as may be required, varying with the form of the original proposition; for example, if the position of A be employed as a minor premiss we may conclude that E, U, O, and Y are false, by employing the major "If A be true, then E, U, O, and Y are all false."

c. Subaltern. *Whatever relation exists between two classes, the same exists between any portions of those classes.* Here will be observed a modification of Aristotle's *dictum;* for when we assert that the whole of one class is or is not contained in another, we must also be able to assert that a portion of it is similarly characterised; and so on, to a full exposition of the canon, with its resulting majors.

d. Subcontrary. *Any two classes must be either mutually and wholly exclusive* (*when, by the last canon, we may assert them as mutually and partially exclusive*), *or they must be mutually and partially inclusive.* This canon is at once seen to be a corollary from the first and third; it can only refer to cases of I and O, the majors being respectively, "If I be false, O is true;" and "If O be false, I is true."

2. Conversion:—

a. Simple. *Those magnitudes which coincide are equal.* This canon, common both to geometry and logic, will hardly be questioned. The explication of its present import is that when two classes, or parts of classes, comprise the same objects, or when two individuals comprise the same ideas, they may at pleasure replace each other as subject and predicate in any form of proposition. We are, therefore, entitled to assume for majors, "If A be true, the corresponding Y is," etc.

b. Privative. *Every object of thought must be either a positive idea or its correlate privative.* Now, since these ideas are mutually and wholly exclusive, we are manifestly enabled to infer the presence of one from the absence of the other, and *vice versâ.* From this development of the canon, we must educe such majors as may be required from time to time; thus —

No immaterialities are material,
All forces are immaterialities;
∴ No force is material.

3. Coincident Junction:—

The canon of this doctrine is, "*Whatever is joined to one of two or more inseparable ideas, is joined to all.*" That is to

say, if we must always think simultaneously of two objects, and we think of one of these at the same time with a third, the other must in like manner be conceived. Accordingly, we may construct as many syllogisms as we please of the following form :—

Whatever may be added to the subject of an admitted proposition may at the same time be added to its predicate,

"Red" may be added to the subject of the admitted proposition, "metals are solids;"

∴ It may be added at the same time to the predicate —*e.g.*, "red metals are red solids."

Thus have I shown that every so-called immediate inference is, in reality, of a syllogistic nature; for let any of the above-mentioned majors be denied, and the conclusion is no longer valid. The object with which I set out is, therefore, attained; but ere I conclude, it will be useful to make a few brief observations upon some detached portions of the subject.

I have then to remark that as regards simple conversion, it must not be thought of as only applicable to tautologous judgments; for, as shown by the table given in page 45, every possible proposition may be simply converted. Nor must it be held that the convertend and its converse are the expressions of the same operations of thought; for confessedly, the respective *subjects* about which we think are different. Therefore, when, speaking of conversion, Sir William Hamilton states ("Logic," Appendix, V. c.) that "it is of no consequence, in a logical point of view, which of the notions collated" are "subject or predicate," he would appear either to have been bestowing too little attention upon the *process* of thinking, or to have expressed himself ambiguously.

I may also mention that Mr. Mill, who repudiates the notion of inference when applied to the above processes, has himself made a remark which affords a key to the whole question. He is alluding to "such considerations as these, that contrary propositions may both be false, but cannot both be true; that subcontrary propositions may both be true, but cannot both be false," etc., etc.; which the reader will immediately recognise as modifications of the canons above given; and says that "in this respect [*i.e.*, as involving general principles], these *axioms* of Logic are on a level with those of mathematics." He also implicitly terms them "elementary generalisations," but yet does not see that any one operation of opposition, etc.,

is as regular a deduction from a "general truth" as is any reasoning of geometry or algebra, which depends upon precisely similar axioms. (Compare Mill's "Logic," Book ii. chap. 1, § 2.)

C.

On the Dictum de Omni et Nullo.

This canon I have enunciated (p. 8) in the following terms:—"Whatever is affirmed or denied altogether of any whole, may in like manner be affirmed or denied of any individual part belonging to, or comprehended in that whole;" and I have here used the word "whole" (the customary term being "class") in order that the principle might be more *obviously* applicable to syllogisms having singular terms. It will, however, be necessary to present in this place a more explicit view of the *dictum* than I have hitherto done; for otherwise, the objections frequently urged against that law might possibly be considered as unanswerable.

We have seen already (article A) that the notion of a class, or a "common notion," is the complex idea of an indefinite number of individual members all possessing the same characteristic, and also that the notion of an individual, or a "singular notion," is the complex idea of an indefinite number of attributes, most of them being class-characteristics, and all possessing the same unity of connection. Therefore, as a "class" and its "members" are, for all present purposes, precisely equipollent with an "individual" and its "attributes," I shall use the terms "whole" and "parts," which will serve equally well to represent either of the former pairs.

We are now able to perceive a fact which lies at the very root of the question, viz., that a "whole" is not composed merely of its "parts," but that it contains in addition the "unity" which obtains among them. And also—as was shown in the sections of this treatise which discussed the subjects of *formal* induction, deduction, extension and comprehension—we know that it is possible to direct at pleasure the major part of our attention upon either of the above con-

stituents of a "whole," upon the "unity," or upon the "parts."

Thus much premised, I have next to point out a very important distinction, viz., the relative powers of conceiving the "unity" and the "parts." The "unity" is obviously a *single* object of thought; the "parts" are, on the contrary, not merely a numerous, but an indefinitely numerous *collection* of such objects: therefore, while it is possible to form a clear and precise notion of the "unity," we can only obtain a vague and indefinite idea of the "parts." Hence it results that we can always direct a greater portion of our attention upon the "unity," than upon the "parts;" for that which we can perform more easily, we can perform better; and as a corollary, we see that the natural disposition of the mind is to regard the "unity" as pre-eminent, the "parts" as subordinate.

The *dictum* results from the facts thus proved: it asserts that whatever is recognised as belonging to, or excluded from, the "whole," when principally looked upon as the "unity," will be found to hold the same relation, not to the "parts" in a body—for they, although vaguely conceived, yet form an essential constituent of the "whole," and are at least *co-extensive* with "unity"—but to any *one* of the "parts," no matter whether it be already known as individually existing, or whether it have yet to be rescued from the depths of indefinity. And as I have formerly shown that all judgments are classifications (Appendix A), and that all reasoning whatever may be exhibited in syllogisms (*passim*)—these doctrines, taken in connection with the proof just now afforded, that the *dictum* is a necessary law of thought, will, I apprehend, make it evident that the Stagirite's canon is the organic principle of all inference.

That the above remarks were not altogether uncalled for, I shall show by quoting the following passage from Mr. Mill's "Logic" (Book ii. chap. ii. § 2); my reason for selecting this author being that he is one of the ablest and best known of the logicians adopting similar views:—

"Now, however, when it is known that a class, an universal, a genus or species, is not an entity *per se*, but neither more nor less than the individual substances themselves which are placed in the class, and that there is nothing real in the matter except those objects, a common name given to them, and common attributes indicated by the name; what, I should

be glad to know, do we learn by being told, that whatever can be affirmed of a class, may be affirmed of every object contained in the class? The class *is* nothing but the objects contained in it; and the *dictum de omni* merely amounts to the identical proposition, that whatever is true of certain objects, is true of each of those objects. If all ratiocination were no more than the application of this maxim to particular cases, the syllogism would indeed be what it has so often been declared to be, solemn trifling. The *dictum de omni* is on a par with another truth, which in its time was also reckoned of great importance, 'Whatever is, is.' To give any real meaning to the *dictum de omni*, we must consider it not as an axiom, but as a definition; we must look upon it as intended to explain, in a circuitous and paraphrastic manner, the meaning of the word *class*." The italics here are Mr. Mill's.

In what points the above passage differs from the doctrine previously advocated, and which view is supported by the more weighty arguments, are questions that must be left for each reader to decide for himself. Suffice it if a clear statement of the facts involved has been put forward.

I have frequently spoken of Aristotle's *dictum* as being the fundamental law of inference; but I should here wish to qualify that expression by stating that I do not use the word "fundamental" in its most explicit sense; that is to say, I do not imply the non-existence of some more recondite and general principle. My only meaning is, that for all logical purposes, it will be sufficient to consider the *dictum*, *i.e.*, the practical law by which the motive faculty of classification works, as the ultimate principle of thought as thought: to the end that we may not be compelled to encroach upon metaphysical ground.

In this connection it may be useful to mention that by many writers the fundamental laws of thought have been given as follows:—

1. The Law of Identity. "A concept is equal to all its characters," or, "A thing is equal to itself."

2. The Law of Contradiction. "What is contradictory is unthinkable."

3. The Law of Exclusion. "Either a given judgment must be true, or its contradictory; there is no middle course."

4. The Law of Sufficient Reason. "Whatever exists or is true, must have a sufficient reason why the thing or proposition should be as it is, and not otherwise."

I shall content myself with having called the reader's attention to these laws, and shall not attempt to discuss them in the present place. I may, however, refer to Sir William Hamilton's fifth and sixth lectures upon Logic, as containing an able analysis of the principles in question.

D.

On the Syllogism considered as a Petitio Principii.

The form which this objection to the syllogism generally assumes is thus stated by Mr. Mill :—

"It must be granted that in every syllogism, considered as an argument to prove the conclusion, there is a *petitio principii*. When we say,

All men are mortal,
Socrates is a man ;
Therefore,
Socrates is mortal ;

it is unanswerably urged by the adversaries of the syllogistic theory, that the proposition, Socrates is mortal, is pre-supposed in the more general assumption, All men are mortal: that we cannot be assured of the mortality of all men, unless we are already certain of the mortality of every individual man: that if it be still doubtful whether Socrates, or any other individual you choose to name, be mortal or not, the same degree of uncertainty must hang over the assertion, All men are mortal: that the general principle, instead of being given as evidence of the particular case, cannot itself be taken for true without exception, until every shadow of doubt which could affect any case comprised with it, is dispelled by evidence *aliundè*, and then what remains for the syllogism to prove? That, in short, no reasoning from generals to particulars can, as such, prove anything; since from a general principle we cannot infer any particulars, but those which the principle itself assumes as known."

"This doctrine," Mr. Mill goes on to add, "appears to me irrefragable," and the mode of issuing from the difficulty which he adopts, is to deny that the syllogism as such is an

JUN — 0 1961

inference. He asserts that the same evidence which enabled us to infer the general truth "All men are mortal," would equally enable us to draw the particular conclusion "Socrates is mortal;" and that a true representation of the reasoning process which takes place, would be to say that as Solon, Lycurgus, Pisistratus, and other individuals possessed the attribute mortality, and as Socrates resembles those individuals in his possession of the attribute humanity, he will therefore resemble them in being mortal. This "type of ratiocination," says Mr. Mill, "does not claim, like the syllogism, to be conclusive from the mere form of expression; nor can it possibly be so. . . . . Whether, from the attributes in which Socrates resembles those men who have heretofore died, it is allowable to infer that he resembles them also in being mortal, is a question of induction; and is to be decided by the principles or canons which we shall hereafter recognise as tests of the correct performance of that great mental operation."

It will thus be seen that in refusing the name of inference (strictly speaking) to syllogistic reasoning, and in referring it to induction, Mr. Mill evidently considers the latter as altogether different in nature from the syllogism. It would not be difficult to quote other passages to the same effect, thus—"This was induction, but bad induction; just as a vicious syllogism is reasoning, but bad reasoning," where the processes of induction and syllogism are contrasted. Consequently, the theory of induction maintained in the body of this treatise, is directly at variance with the views just stated; for I have endeavoured to show that the inductive process is merely a peculiar species of deductive (syllogistic) inference, and depends altogether upon reasonings which assume the form of syllogisms. It is necessary, then, to produce some considerations which shall serve to establish the fact that Mr. Mill is mistaken in supposing induction to be independent of syllogism.

Now this point may, I think, be proved by using Mr. Mill's own words. First, as regards inductions in general, I find the following statement:—"It hence appears that if we throw the whole course of any inductive argument into a series of syllogisms, we shall arrive, by more or fewer steps, at an ultimate syllogism, which will have for its major premiss the principle, or axiom, of the uniformity of the course of nature." A passage like this might apparently be held as

an admission of all that I require to prove; I shall, however, push the matter a little further, and ask, Upon what does Mr. Mill rest his "ultimate major premiss?" The answer I find to be, "We arrive at this universal law, by generalisation from many laws of inferior generality." But here another step presents itself, which leads us to inquire what it is that gives validity to this last-mentioned "generalisation," which is described in another place as being an "induction by simple enumeration—in other words, generalisation of an observed fact from the mere absence of any known instance to the contrary;" or, to vary the expression, what makes us certain that the conclusion to which this generalisation conducts is true? The only approach to a reply which Mr. Mill gives, is as follows:—

"The considerations which, as I apprehend, give, at the present day, to the proof of the law of uniformity of succession, as true of all phenomena without exception, this character of completeness and conclusiveness, are the following:—First, that we now know it directly to be true of far the greatest number of phenomena; that there are none of which we know it not to be true, the utmost that can be said being that of some we cannot positively from direct evidence affirm its truth; while phenomenon after phenomenon, as they become better known to us, are constantly passing from the latter class into the former; and in all cases in which that transition has not yet taken place, the absence of direct proof is accounted for by the rarity or obscurity of the phenomena, our deficient means of observing them, or the logical difficulties arising from the complication of the circumstances in which they occur; insomuch that, notwithstanding as rigid a dependence on given conditions as exists in the case of any other phenomenon, it was not likely that we should be better acquainted with those conditions than we are."

Accordingly, the *observed* ground for the conclusion that all phenomena have a cause, is the fact that *some* have; but there is no reason assigned for such an inference being valid. I can therefore only suppose that Mr. Mill implies the existence of some mental law which assures us of a particular uniformity so characterised being sufficient to warrant the truth of the corresponding general uniformity. And this view is borne out by such statements as this—"The unprompted tendency of the mind is to generalise its experience provided this points all in one direction," which are to be

frequently met with in the work quoted. The result, then, at which we finally arrive, is that the mind supplies a general law, according to which, if certain facts are ascertained by observation, a fixed conclusion must be obtained. Let us state this mental law, the observed facts, and the conclusion in the order named, thus :—

A case of a certain particular uniformity is a case of the corresponding general uniformity,
The case of some phenomena being caused is such a particular uniformity ;
∴ The case of some phenomena being caused is a case of all phenomena being caused.

This evidently is nothing but a syllogism, and indeed is precisely the same syllogism as that to which, in the body of this treatise, I traced all induction. A comparison of the investigation then followed out, with that just concluded, will thus show that Mr. Mill implicitly, and myself explicitly, are agreed in considering induction as but a species of syllogistic inference.

It now remains to prove that the syllogism is not obnoxious to the charge of depending upon a *petitio principii ;* and this may, I think, be done in two ways. First, making use of the fact recently established, that all reasoning whatever is syllogistic, it can fairly be maintained, that even if it were impossible to directly point out any flaw in the argument supporting the charge; yet there must of necessity be one somewhere, or otherwise no valid inference could ever exist. But, secondly, the alleged fallacy may be disposed of, in the following manner, by a reference to the simple processes of thought.

Taking the example already used, *i. e.*, "All men are mortal, Socrates is a man ; therefore, Socrates is mortal," let us consider whether or not the major premiss *alone* contains the conclusion. The subject is the class "man" taken universally, that is, as a whole, and accordingly, the object which occupies our thoughts is composed principally of the unity "humanity." The predicate is the class "mortal things," considered mainly with reference to a portion of its "parts ;" and the import of the entire judgment is that "humanity" is one of the unities possessing "mortality," and that the parts which are connected together by humanity form a complex portion of the parts connected by mortality. Now the only assertion which is here made respecting individual objects is

that any case of "*humanity*" is a case of "mortality," and therefore it is *not* implied that any *intuition* such as Socrates, Plato, or Junius, is mortal, *until* such intuition has been analysed and found to contain "humanity." Then, indeed, I grant, the major premiss implies the conclusion; *but then*, it must be borne in mind, we are also in possession of the *minor premiss, without which the conclusion would not be so implied.* Accordingly, the major tells us that the *general notion* "man" forms a portion of the general notion "mortal things;" the minor, that the *intuition* Socrates forms a portion of the general notion "man;" the conclusion, that the *intuition* Socrates forms a portion of the general notion "mortal things." And thus it will also be seen, that both the major and minor premises *separately* contain the conclusion *when* both are admitted; but that, unless this be the case, *neither* of them does. Therefore, as *both* premises are essential to the conclusion, there is no *petitio principii.*

The above is necessarily but a mere outline of the argument by which the syllogistic theory, as ordinarily, and I apprehend, justly received, may be defended. The full details cannot here be set forth, and therefore I must ask the reader to supply them himself, a task which will be easy when once he is in possession of the key to the whole question, viz., when he perceives the distinction which must be made between an *intuition as an intuition*, and an *intuition resolved into its constituting general notions.*

In this article, the work quoted from is Mr. Mill's "Logic," and I annex a list of the passages referred to, in the order of their occurrence above.

Book ii. chap. iii. § 2.
Do. do. § 7.
Book iii. chap. iv. § 3, note.
Do. chap. iii. § 1.
Do. chap. xxi. § 2.
Do. do. § 4.
Do. chap. iii. § 2.

J. S. VIRTUE, PRINTER, CITY ROAD, LONDON.

Digitized by Google

Photography, a Popular Treatise on. Also a Description of, and Remarks on, the Stereoscopic and Photographic Optics, &c. By Monckhoven. Translated by W. H. Thornthwaite, Ph.D., F.C.S. Illustrated, 1s. 6d.

Astronomy, Rudimentary. By the Rev. Robert Main, M.A., F.R.A.S., First Assistant at the Royal Observatory, Greenwich. Illustrated, 1s.

The Metropolitan Building Act, 18th and 19th Victoria, cap. 122. Followed by Appendices of the Unrepealed Sections of the former Building Acts, 14th Geo. III., c. 78, and 7th and 8th Vic., c. 84, and the Sections of the City of London Sewers Acts, 1848 and 1851, relating to Buildings. With Notes and Index by David Gibbons, Esq., of the Middle Temple, Special Pleader, and R. Hesketh, Esq., Architect and District Surveyor. Illustrated, 2s. 6d.

The Metropolis Local Management Act, 18th and 19th Vic., c. 120; 19th and 20th Vic., c. 112; 21st and 22nd Vic., c. 104; 24th and 25th Vic., c. 61; also the last Pauper Removal Act, and the Parochial Assessment Act, comprehending all that is essential for the use of Members of Parish Vestries, and the Local Managers of the Metropolis. 1s. 6d.

The Metropolis Local Management Amendment Act, 1862, 25th and 26th Vic., c. 120. With Notes and an Index. 1s.

The Nuisances Removal and Diseases Prevention Amendment Act, 18th and 19th Vic., c. 121. To which are added The Smoke Nuisance Act and the Common Lodging House Act. With Notes and an Index. 1s.

Field Artillery on Service, on the Use of; with especial reference to that of an Army Corps. For Officers of all Arms. By Taubert, translated by Lieut.-Col. Henry Hamilton Maxwell, Bengal Artillery. 1s. 6d.

Six Legislative Enactments for the Guidance of Contractors, Merchants, and Tradesmen. I. An Act to facilitate the remedies on Bills of Exchange and Promissory Notes. II. An Act to amend the Laws relating to Stamp Duties, and on Bonds and Securities. III. The Newspaper Stamp Act, and the Transmission by Post of Periodicals, &c. IV. An Act to consolidate the Excise and Stamps and Taxes into one Board. V. An Act for facilitating arrangements between Debtors and Creditors. VI. An Act to amend the Law of Insolvency, Bankruptcy, and Execution. With an Index. 1s.

Swords, &c., Memoir on. By Col. Marey, translated by Lieut.-Col. H. H. Maxwell. With Notes. Illustrated, 1s.

Modern Farming, Outlines of. By Robert Scott Burn.

Vol. I.—Soils, Manures, and Crops. Illustrated, 2s.

Vol. II.—Notes, Historical and Practical, on Farming and Farming Economy. Illustrated, 3s.

Vol. III.—Stock—Cattle, Sheep, and Horses. Illustrated, 2s. 6d.

Vol. IV.—The Management of the Dairy—Pigs—Poultry. With Notes on the Diseases of Stock, by a Veterinary Surgeon. Illustrated, 2s.

Vol. V.—Utilisation of Town Sewage—Irrigation—Reclamation of Waste Land. Illustrated, 2s. 6d.

Complete in 2 vols., cloth boards, 14s.

The Law of Friendly, Industrial and Provident, Building, and Loan Societies, a Handy Book on. With Copious Notes. By Nathaniel White, Esq. 12mo., 1s.

Logic, Pure and Applied, a Treatise on. By S. H. Emmens, Esq. 12mo., 1s. 6d.

Investing Money, Practical Hints for: with an Explanation of the Mode of Transacting Business on the Stock Exchange. By Francis Playford, Sworn Broker. Third Edition, revised and corrected. 12mo., 1s.

Deacidified using the Bookkeeper process.
Neutralizing agent: Magnesium Oxide
Treatment Date: Sept. 2004

PreservationTechnologies
A WORLD LEADER IN PAPER PRESERVATION
111 Thomson Park Drive
Cranberry Township, PA 16066
(724) 779-2111

LIBRARY OF CONGRESS
0 013 123 181 7